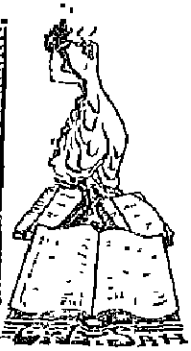

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THE

HIMÁLAYAN DISTRICTS

OF THE

NORTH-WESTERN PROVINCES OF INDIA.

EDWIN T. ATKINSON, B.A., F.R.G.S.

VOL. I.

(FORMING VOLUME X. OF THE GAZETTEER, N.-W. P.)

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1882.

~~PHILANDER SMITH COLLEGE,~~
~~NAINI TAL.~~

PREFACE.

The system of transliteration used in the present volume is that which has been adopted in the Gazetteer of the North-Western Provinces. For the vowels it is briefly as follows :—

a	as in	‘woman.’	*u*	as in	‘pull’
á	„	‘father.’	*ú*	„	‘rule’
e	„	‘grey.’	*ai*	„	‘aisle.’
i	„	‘bit.’	*o*	„	‘hole.’
í	„	‘machine.”	*au*	as	‘*ou*’ in ‘house’ (nearly).

The original plan of this Memoir provided for a thorough examination of the country between the Tons and the Káli somewhat on the plan of Tennent's Ceylon, and in addition a less detailed summary of our knowledge of the Himálaya-Tibetan region. It was believed that only thus could the physical unity and with it the historical connections of the entire region be correctly understood. From or through the Himálaya came the pre-Aryan and Aryan races now inhabiting India, as well as the successive waves of Baktrian, Skythian, and Musalmán invaders who have conquered India in historical times. As we shall see hereafter, forms of belief having their origin in or beyond the Himálaya have influenced the religious systems of India from the earliest ages to the present day, so that for the political and religious history of the plains an adequate conception of the physiography, ethnography, and history of the Himálaya-Tibetan tract is a necessary preparation. It is to be regretted that this extended programme cannot be carried out, but the pressure of official duties prevents its completion, and all that can now be attempted is to work up the materials that have been collected for the Himálayan districts of the North-Western Provinces. At the end of Chapter I. will be found a series of ‘References’ to materials illustrating the history and resources of the Himálaya from Asám to Afghánistán. These were collected in continuation of a plan suggested by Mr. R. N. Cust in 1866 for the preparation of a ‘Catalogue raisonné of every kind of printed information connected with the North-Western Provinces;’ and I certainly know of no better aid to good administration than an index to the special and local reports of those engaged in it. The necessity for such a catalogue has ceased in great part wtih the publication of the District Memoirs, but there are subjects of general importance which the publication of the local accounts does not subserve. One of these is the history, using this word in its widest sense, of the Himálaya-Tibetan region, and I offer the references as the nucleus of a complete index to our knowledge of its physiography, products, peoples, and institutions.

As observed in the foot-note to Chapter I., much remains to be done, but at the same time very much more has been accomplished than is generally known. Scientific and economic botany have been carefully explored; the chapter on economic mineralogy leaves little to be desired: those on meteorology and geology have been brought up to the level of our present scientific knowledge; and the introduction to physical geography gives a popular and suggestive summary of the information that we possess, whilst the references afford a guide to materials for the study of details. All this is new, or embodies information buried in correspondence and reports, and practically as inaccessible to the public as if it had never been committed to writing. To General Richard Strachey I am indebted for the use of an unpublished work of his own on the physical geography of the Himálaya, which has been specially made use of in the chapters on 'Geology' and 'Meteorology.' Mr. H. B. Medlicott, Superintendent of the Geological Survey of India, prepared the chapter on 'Geology,' and Mr. S. A. Hill, Meteorological Reporter to the Government of the North-Western Provinces, contributed the valuable chapter on 'Meteorology.' Dr. King, Superintendent of the Royal Botanical Gardens, Calcutta, furnished the list of the *flora* of Western Garhwál, Dehra Dún, and Jaunsár-Báwar, and Dr. Watson, the list for Eastern Garhwál, Kumaon, and the Bhábar. To General Strachey I am further indebted for the list of plants collected by himself and Mr. Winterbottom in Kumaon, Garhwál, and the neighbouring parts of Tibet, and which has never before been published. This list has been admirably edited by Mr. F. Duthie, Superintendent of the Botanical Gardens at Saháranpur, to whom also I am indebted for the sketch of the history of the Tea industry in the Himálayan districts. The sheets of the portions relating to economic botany have had the criticism of Dr. Watson and Mr. Duthie; and for the forest history Mr. Greig and Major Garstin have advised me in many matters of detail.

Of the maps, the map of Kumaon was prepared under the instructions of Colonel Walker, R.E., Superintendent of the Great Trigonometrical Survey, and is the result of great labour and care for detail: indeed, a less accurate map might possibly be more useful. The great 'one-inch to one-mile' sheets were photographed down to a smaller scale and sent to me. I then obtained the correct names in Hindi of all the villages, rivers, &c., in Kumaon and Garhwál (about 8,000) and entered against each the correct transliteration for use in a new edition of the large maps, and then drew up a draft list of names for the district map. I desired to enter the names of all halting-places on every ordinary route; villages in which the patwári usually resides; places of note; trade-centres; and all villages containing over one hundred inhabitants. After much trouble, correspondence, and inquiry, this was fairly accomplished. The villages retained were marked off on the photographic copies of the maps, and these were returned to the Surveyor-General with lists showing the actual and revised spelling for the further compilation. In addition, the principal lines of road have been laid down, and for the first time the pattis or subdivisions adopted at the recent settlement by Mr. J. Beckett have been shown. In the trans-Himálayan portion to which the survey had not extended I have added places from the village maps prepared by the patwáris, and in their selection was aided by Mr. Beckett. The map of the Himálaya-Tibetan region is taken from one prepared by Mr. Trelawny Saunders, omitting the eastern portion. The geological map is a revised copy of that which accompanied General Strachey's paper 'On part of the Himálaya Mountains and Tibet' read before the Geological Society in 1851. It may be necessary to explain that these volumes are not intended to be solely a popular account of the districts which they describe, but to contain, first of all, a record of all facts of permanent scientific or economic value, that have been gathered by me during my visits to Kumaon and the Dehra Dún or which have been contributed by others. This work has occupied my leisure time for several years, and I can only hope that the labour and care bestowed on it will be of some use to my successors, and enable them to produce a more worthy record for those who are truly interested in the moral and material progress of the North-Western Provinces.

Bombay,
17th December, 1881.

E. T. ATKINSON.

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THE

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PART I.

CHAPTER I.

INTRODUCTORY.

Limitation of this work—Systematic geography—Herbert; Vigne, Jacquemont, &c., Hodgson; R. Strachey; Thompson, Cunningham, H. Strachey; Rawlinson, Saunders; Markham; *Calcutta Review;* Blanford—Nomenclature—Ethnical sketch: Plains of Asám and Bengal; Plains of Upper India; Clothing; Food; Customs; Eastern Himálaya—Eastern tribes, Tribes of the Southern Watershed; Bhután; Sikkim; Nepál; Tribes of the Lower Himálaya—Karnáli to Tons; Bisahr; the Satlaj to the Indus—Afghánistán, Galcha States; Kára-Tangutans; Tibet—General distribution—Appendix: list of authorities for this Chapter.

Limitation of work.[1]

UNDER the name Himálayan districts of the North-Western Provinces of India we include the British districts of Kumaon, Garhwál, Tarái, Dehra Dún and Jaunsár-Báwar, and the independent State of Tihri or foreign Garhwál, comprising the tract within the Himálaya bounded by the

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[1] The collection of materials for the 'Memoir on the Kumaon Himálaya' has been in progress since 1872, but other and more pressing duties have hitherto prevented their arrangement for publication. It was then intended to give as complete a description of the entire Himálaya as the means at our disposal would permit. There is little hope, however, that the leisure necessary for such an undertaking will occur within any reasonable time, and it therefore seems better to work up the materials already existing in their present form than to wait until opportunity is found for completing the original design. There are many and great gaps in our information regarding Kumaon, but the first step towards remedying this defect will be this attempt to take stock of our present knowledge, which is far more complete than is supposed. Without the aid of the materials entrusted to me by General R. Strachey, Sir John Strachey, Mr J. H. Batten, Rudradatta Pant, and others, whose assistance will be found acknowledged in the preface, as well as the co-operation of Mr. H. B Medlicott, Mr. S. A. Hill, Mr. Duthie, Dr. King, Dr. Watson, Captain G. Marshall, and others, my own work would be very meagre and unsatisfactory, as well from the great range of subjects discussed as from their frequent special and technical character.

Tons on the west, and the Káli or Sárda on the east. The adjoining portion of Tibet, to which British subjects resort for the purposes of trade, or in order to visit the sacred lakes, also comes within the scope of our investigations. A glance at the accompanying map will show that both the Himálayan and Tibetan portions of the tract with which we are concerned form but a small slice or segment of a greater system, which must be studied as a whole before an adequate conception of the structure and relation of its parts can be arrived at. The Himálaya itself is but the southern belt of that great girdle of mountains which encloses within them the country of which the southern half is commonly called Eastern Turkistán. From or through the southern slope of the Himálaya flow the great rivers known as the Indus, Ganges, and Brahmaputra. To the east, the continuation of the Himálaya is traced in the mountain ranges through which flow the Yang-tse-kiang and the Hoang-ho, and which are prolonged to the north in the Ala-shán, In-shán, and Khing-han mountains. The last of these ranges joins the Yablonnoi Khrebet branch of the Altai system at right angles in about 55° north latitude. The Yablonnoi mountains are the north-eastern continuation of the Altai range and form the water-parting between the Lena and the Amour. The Altai rises, on the right bank of the Irtish river, at the north-western angle of the central plateau, and separates the Upper Gobi from the Siberian steppes. It consists of a belt of mountains varying in breadth from 400 to 1,000 miles, though in one place contracting to 150 miles, of no great elevation, and descending in a succession of broad terraces to the Siberian plains. It is pierced by the rivers draining into Lake Baikal, and, east of the 88th meridian, consists of three almost parallel ranges—the Saiansk, Tangnou, and Ulangomula. From the sources of the Kára-Irtish the Barluk Orochuk and Zungarian Ala-tau connect with the Tian-shán, the Celestial mountains of the maps, in which are the sources of the Syr-Darya or Jaxartes. The Tian-shán to the north and north-east of Káshgar consists of a series of parallel ranges having a direction from the east to west and an increased elevation as they proceed northwards. They abut on the elevated mountainous region known as the Alai and Pámir plateau, the latter of which contains the source of the Oxus in the little *kul* or lake of the lesser Pámir. The eastern margin of the Pámir is described by M. Severtsof, who visited it in 1878, as neither a mountain chain nor the precipitous extremity of a table-land, but an extensive mountainous region filled with numerous ranges. The peak measured by Hayward (21,000 feet), and the Tágharma or Muztágh-Ata peak measured by Trotter (25,350 feet), and supposed to form a part of the Kizil-Art range connecting the Tian-shán with the Himálayan system, are now reported to be only the culminating points of groups of snowy peaks separated from each other by a distance of over thirty miles. The intervening country contains the basin of the little Kára-kul lake surrounded by a complicated system of short and comparatively low mountain ranges having an altitude of from 14,000 to 15,000 feet. These ranges, however, connect with the Hindu Kush, Kárakoram, and Western Himálaya, and thus complete the girdle of mountains from one or another side of which flow all the great rivers of Asia.

Eastern Turkistán

The country thus defined forms a part of the great Empire of China. To the south lies the rugged, elevated plateau of Tibet, regarding which we shall have more to say hereafter. To the north of this comes the depression known as the Lob-nor basin, which receives the drainage of the northern slope of the Tibetan plateau called, in the 39th degree of north latitude, the Altyn-Tágh range, but more generally known as the Kuen-lun, a name given probably from some well-known pass. The drainage from the eastern slope of the Tian-shán flows in the same direction, as well as that from the south-eastern slopes of the Altai range ; but all is swallowed up in the great sandy desert of Gobi, which at one time apparently formed the bed of an ancient sea some 300,000 square miles in extent. According to Prejevalsky this plateau varies in height from 6,000 feet on the margin to about 2,000 feet in the middle. It is intersected from west to east by a depressed valley called Shamo, or 'sea of sand,' containing salt. West of this lies the Han-hai, or 'dry sea.' Prejevalsky has crossed the desert between Kuldja and what may turn out to be Lob-nor, lying in east latitude 90° and north latitude 39° 30,' and found himself at only 2,500 feet above the level of the sea on the banks of the Tarim. To the west, the desert presented a thin loam impregnated with salt, and to the east a plain of drift-sand. Towards the Kurugh-tágh hills, from which he descended on the desert, lay a belt of pebble and gravel some 15 to 18 miles wide. He also crossed the desert to the north between the Ala-shán range and Urga, where he found it to vary in height between 3,000 and 5,500 feet, whilst it still preserved its sandy character. On the route between Urga and Kalgan explored by the same traveller, there is a great depression towards the middle, where the elevation is as low as 2,400 feet. Here the soil of the Gobi proper is composed of coarse reddish gravel and small pebbles interspersed with drifts of yellow shining sand. Leaving these regions, we shall in future restrict ourselves to the southern plateau, of which the Kuen-lun mountains are the northern boundary, and which is so intimately connected in its physical relations with the Himálaya.

Early attempts at generalisation.

Before proceeding with our examination of the structure of the Himálaya-Tibetan region, it will be convenient to pass in review the different theories[1] that have been advanced in regard to its systematic geography, since a complete understanding as to what has been done in this direction will enable us to arrive at some conclusion as to what remains to be done. Captain Herbert, who conducted the mineralogical survey of the Himálayan country between the Káli and the Satlaj in 1818, was the first who attempted to give a general account of its physical characteristics. His description[2] was intended to serve as an introduction to his geological account of the Himálaya, as well as to be a distinct contribution to general geography; the existing works on the subject "being singularly deficient in details, as well as erroneous in the few that are given." His idea of the country north of India was apparently derived only from maps. He describes it as a large central space strongly marked by the feature that it was little intersected by rivers, whilst from its sides flowed the streams which united to form the greatest rivers in the world. As the source of every river must be higher than any other part of its course, he inferred that the zone in which those rivers originated must be higher than the plains through which they flowed to seek the ocean, and that the entire central tract itself was completely surrounded by lofty mountains. He considered the upper beds of the Brahmaputra

Herbert

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[1] For a brief summary of these theories see Mr C. R. Markham's 'Memoir on the Indian Surveys,' p. 311.

[2] *J. As. Soc. Ben.*, XI., Pt. I., p. x.

and the Satlaj as forming part of the barrier zone which surrounds the central tract, and not as a part of the plateau itself. He further showed that the true "line of boundary is undoubtedly the chain of water-heads, and that this is by no means synonymous with the line of greatest elevation." At first view the arrangement of the mountain masses in the tract between the Káli and the Satlaj appeared to be irregular and confused, but by tracing the courses of the rivers and their tributary streams, a clue was found to lead the observer out of this labyrinth. "By connecting their sources and by following out the devious windings of the several feeders, an idea is obtained of the extent, the direction, and the connection of the several ranges. * * * Instead of a succession of parallel and continuous ranges running south-east to north-west, and rising one behind the other in regular array and increasing elevation till the series is closed in the farthest distance by the line of snow-clad peaks, we see only one continuous range of any extent forming an irregularly curved line which bends round the tract, commencing on the north-east angle, and with a north-westerly direction, which it gradually alters to a south-easterly one on the south-west angle, and latterly due south just before it is lost in the plain country. This range forms one of the boundaries of the basin of the Satlaj which bends around the convex side, while within its concavity are contained the numerous sources of the Ganges." This he called the Indo-Gangetic chain, "a ramification of that more extensive line of water-heads which would exclude from the central plateau all the mountain tract watered by the Sanpu and the Indus as well as by the Ganges. Next in extent are the two principal ramifications separating the basin of the Jumna from that of the Ganges, and the basin of the latter from that of the Káli. From these two principal ramifications proceed a number of minor ones which, but for the assistance derived from a study of the course of the rivers, would almost bid defiance to any analysis. Transverse ridges, several thousand feet higher in elevation, ramify from the Indo-Gangetic chain towards the Ganges basin, and a line or plane connecting their summits would be that of the greatest elevation, which, however, has no connection with the disposition of the water-heads. It is a fact that in a line of 500 miles two summits are found exceeding five miles in perpendicular height, not isolated, but connected to appearance by a regular series of peaks of very little inferior elevation. If we confined ourselves to heights of 21,000 feet, we should find a connected line of peaks extending over 1,000 miles; that is, one apparently without breaks, but in reality connected only through the line of water-heads from which they ramify. Whether the word 'line' or 'plane' is used, the idea of considerable breadth must be conceded, and in that case its surface would be very irregularly studded with peaks, and in this way it may be said to be parallel to the common boundary of mountain and plain land, and to intersect instead of bounding the river districts." The above summary gives a *résumé* of Herbert's speculations on the physical structure of the Himálaya. His errors were those of his time, when the knowledge even of descriptive geography was in its infancy. He was unable to recognise the unity of the great central mass and its bulwarks, and was wrong in saying that the groups of snowy peaks intersected the river basins, when, in fact, they bound the drainage area, and are the determining causes of its existence. Still Herbert is to be remembered as the first who attempted to give a systematic account of the Himálaya as a whole,[1] and is therefore worthy of a prominent place in this brief notice of its geography.

Hodgson.

Next to Herbert comes Hodgson, who in an admirable article in the Asiatic Society's Journal[2] also alludes to the difficulty experienced by a traveller in the Himálaya in getting "rid of that tyranny of the senses which so strongly impresses almost all beholders of this stupendous scenery with the conviction that it is a mighty maze without a plan." His first step towards freedom was his grasping the fact "that the vast volume of the Himálayan waters flows more or less at right angles to the general direction of the Himálaya, but so that the numberless streams of the mountains are directed into a few grand rivers of the plains either at or near the confines of the two regions." Secondly, a study of the river systems like the "Sapt Gandaki" and the "Sapt Kausiki" urged him "to discover, if possible, what cause operated this marked convergence of innumerable transverse parallel streams, so as to bring them into a series of distinct main rivers." Thirdly, he found that "the transcendant elevation and forward position, at right angles to the line of gháts of the great snowy peaks, presented that casual agency: the remotest radiating points of the feeders of each great river being coincident with the successive loftiest masses belonging to the entire extent of the Himálaya." The great peaks bound and do not intersect the principal Alpine river basins, as Herbert had thought, and, by so bounding, create the basins, whereas their intersection would destroy them. Hodgson's Himálaya proper is the ghát line or watershed between Tibet and India, and the watershed between the valleys of the Indus and Sanpu and the great plateau is called by him the Nyenchhen Thangla chain. The cause of the convergence of the various streams which form the great rivers upon or near the verge of the plains is shown by him to be "the superior elevation of the lateral barriers of these river basins, between which there are synclinal slopes of such decided preponderance that they overrule the effect of all other inequalities of surface, how vast soever the latter may sometimes be." These lateral barriers are crowned by the great peaks which stand forth from the watershed and send forth southward ridges proportionally immense. Equally effective with the divergent power of these peaked ridges is the convergent power of two ridges upon the single contained river basin. "The synclinal lines from the inner faces of the two adjacent ridges draw the waters together, and because these ridged peaks are the loftiest masses of the entire mountains, the effect of all other masses, even that of the spine of Himáchal or the ghát line of the snows, is overruled or modified, so that in the most rugged region on earth a very limited series of distinct main rivers appear in the plains from innumerable independent Alpine feeders." We may assume that where the loftiest peaks occur, there is a proportionate intumescence of the general mass, and therefore that these grand peak-crowned ridges determine the essential character of the aqueous distribution along the entire line. A further proof is adduced from the fact that the lower rivers, which take their rise in the middle region, do not show this unitizing principle, such as the Bágmati and Rámganga. With regard to the mountain systems, Hodgson divides them into the lower, central, and upper; sub-dividing the first into the sandstone range with its contained Dúns or Máris, the Bhábar or *sál* forest, and the Tarái. The lower region extends from the level of the plains to 4,000 feet above the level of the sea; the central region from 4,000 to 10,000 feet; and the upper region to the watershed or ghát line: divisions which fairly correspond with the distribution of both organic life and inorganic matter. Though unable to follow Mr. Hodgson in all his theories and the deductions that he draws from them, credit must be given for his recognition of the position of the great mountain masses in regard to the alpine river basins and for his appreciation of the influence of climatic conditions on the animal and vegetable world.

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[1] Neither Moorcroft, Vigne, Jacquemont, Hooker, Shaw, Henderson, nor Bellew attempt any description of the *Himálaya as a whole*.

[2] *J. As. Soc. Ben.*, XVIII., Pt. II., p. 761.

Captain R. Strachey.

Dr. T. Thomson.

Captain (now General) R. Strachey, in his paper on the Physical Geography of the Provinces of Kumaon and Garhwál, read before the Royal Geographical Society[1] in 1851, pointed out distinctly for the first time that the Himálaya was in truth the broad mountainous slope of the great Tibetan table-land descending to the plains of Northern India, while a slope of corresponding character descending to the north is known as the Kuen-lun. He remarks that the great peaks in Kumaon and Garhwál "are not found on a continuous ridge, but are grouped together in masses that are separated one from the other by deep depressions, through which flow the streams that drain those parts of the mountains that are immediately contiguous to the north." To the east the same sort of arrangement obtains, but to the west it is much less distinct. The river-beds to within a distance of ten miles in a direct line from the snowy peaks seldom exhibit a rise of more than four or five thousand feet; but when we cross "the line on which the great peaks are situated, the ascent very rapidly increases, and a very few miles carries the river-bed up to an altitude of nine or ten thousand feet; thus showing that the sudden increase of height of the mountains along this line is not confined to the peaks alone, but is a general elevation of the whole surface." Dr. Thomson[2] substitutes the name cis-Satlaj Himálaya for Herbert's Indo-Gangetic chain, and gives the name trans-Satlaj Himálaya to the chain which, commencing in Kailás, separates the waters of the Satlaj from those of the Indus. He refers to these two great chains the whole of the mountains between the Indus and the plains, and says: "The northern boundary

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[1] *J. R. G. S.*, XXI, p. 57, adopted in Somerville's Physical Geography, 7th edition, London, 1877, p. 56.

[2] *Travels*, p. 456.

Major A. Cunningham.

Captain H. Strachey.

of Tibet is formed by the great chain north of the Indus, to which Humboldt gave the name Kouen-lun": and again, that every part of Tibet is traversed by mountains having their origin either in the trans-Satlaj Himálaya or the Kouen-lun. So far the unity of the Himálaya-Tibetan region is acknowledged by this distinguished traveller. Major A. Cunningham[1] makes the Bara-lacha range, which forms the watershed between the Indus and its five affluents, the continuation of the main Himálaya or watershed between the Sanpu and the Ganges. To the south of this lies two distinct and independent ranges stretching in the same general direction from south-east to north-west, which he calls the mid-Himálaya, or Pir Panjál, and the outer or sub-Himálaya, leaving the name Siwálik unchanged for the lowermost sandstone ranges. Beyond the Himálaya the same system of parallel chains is observed, comprising at least three distinct ranges of mountains, which Cunningham proposes to call the trans-Himálayan, or that which divides the head waters of the Satlaj from those of the Indus and extends to the western limits of Rongdo and Astor; second, the Kailás or Gangri range which runs through the midst of Western Tibet along the right bank of the Indus to its confluence with the Shayok; and third, the trans-Tibetan range, also called Bolor and Kárakoram. These distinctions are however, purely local and geographical and are so far convenient and to be accepted. Captain H. Strachey, in his paper[2] on the Physical Geography of Western Tibet, shows us that the Indian watershed is not the Great Himálaya as seen by the Indian observer, but is found in a succession of valley heads much depressed and penetrating that mass to such a depth that the passes from India to Tibet are never visible from any station fairly south of the perpetual snow. The Turkish watershed divides the waters of Tibet from those of Turkistán, including Khoten and Káshgar. "The general plan of the mountain system of Western Tibet appears to consist of a series of parallel ranges running right across the breadth of the table-land in a direction so extremely oblique to the general extension of the whole as often to confound the one with the other, or to convert the transverse direction to a longitudinal one. Short transverse necks connecting the main ranges in some parts, and cross fissures cutting through them in others, together with projecting spurs of a secondary order, will suffice to convert the supposed primary arrangement into all the existing variety of valley and drainage.**The great snowy peaks lying mostly on the terminal butt-ends of the primary ranges, sometimes widened by lateral spurs; and the Tibetan passes crossing the low connecting links, whose alignment forms the main watershed, but not the main mountain-crest." Sir H. Rawlinson[1] recognises the unity of the entire mass, and writes that the "whole country between India and Tartary may be considered as a broad mountain range, the Himálaya forming the southern crest, and the Kuen-lun the northern. The direction of this range is from east to west, trending to the northward, while the parallel chain which bounds Siberia to the south, and the outer crest of which is the Tian-shán, trends somewhat to the south; so that at a short distance to the west of Yárkand and Káshgar the great interior depression of Chinese Tartary terminates, and the bounding ranges coalesce in the elevated table-land of Pámír."

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[1] Ladák, p. 41.

[2] London, 1854.

Sir H. Rawlinson.

Mr. Saunders' theory.

We have now come to the theory set forth by Mr. Trelawny Saunders,[2] Geographer to the India Office, according to whom the summit of the Himálaya consists of a double range of peaks enclosing a series of valleys running parallel to the axis of the mass, and which he would call the northern and southern Himálaya respectively. The first of the two forms the water-parting between the Ganges basin and that of the Sanpu. To the latter must be assigned nearly all the great snowy peaks which are seen from the plains of India, and which are separated from the former by the valleys already mentioned. These valleys are comparatively elevated, and at length burst through the southern range by intersecting gorges. Both Herbert and Hodgson are set aside, and the great peaks are described as forming a chain, broken at intervals by intersecting gorges. "The upper valleys of the Sanpu, the Satlaj, and the Indus appear to form a huge elevated trough separating the Himálaya from the northern part of the table-land of Tibet and from the snowy range into which the table-land contracts at its western end." This range is crossed by the Muztágh, Kárakoram, and

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[1] England and Russia in the East: London, 1875, p. 236.

[2] Sketch of the Mountains and River Basins of India: London, 1870.

and Changchenmo passes, and is remarkable for the great length of its glaciers and the great height of its peaks. The Indus forms its southern base as well as the northern base of the Himálaya. The Indus, Satlaj, and Sanpu, "are the only rivers which, washing the northern base of the Himálaya in channels parallel to the range, break through the entire breadth of the range and water the plains at its southern base." The eastern base of the mountainous highland of Tibet is marked by the Min river, and on the north-east the slope is defined by the basin of the Hoang-ho. From the latter river westward to the Muztágh the Kuen-lun mountains descend to the plains of Gobi from the northern edge. These unite with the Himálaya, Pámír, and Hindu Kush in the lofty peak or knot called Pusht-khar or Tághdambash. The accompanying map, prepared by Mr. Saunders for Mr. C. R. Markham's Memoir on the Indian Surveys, will illustrate better than any further quotations his views on the subject of the relations of the great mountain systems, as well as serve our own purpose. Mr. Markham[1] divides the Himálayan system into three great culminating chains, which he calls the inner, central, and outer, running more or less parallel to each other from the gorge of the Indus to that of the Dihong. "The lofty region of Great Tibet lies mainly between the inner and outer range, with the central chain, whence most of the rivers of Northern India take their rise, running through its length." The western extremity of his inner and most northern range is the Kárakoram, which separates the Indus valley from the affluents of the Lob-nor system, and the eastern section is the Gangri mountains of the map, the Nyenchhen Thangla of Hodgson and Ninjinthangla or Nyenchhen-tang-la of Markham, which commences in peak or knot called Kailás. Parallel to the northern range runs the central range, the eastern section of which commences at the Mariam-la pass near the Kailás peak. "Here a comparatively low saddle connects the northern and central ranges and separates the valley of the Satlaj from that of the Brahmaputra. To the eastward the northern side of the central chain forms the southern watershed of the Brahmaputra, whilst on its southern slopes are the sources of many important rivers, which, forcing their way through the southern chain of the Himálaya, eventually join the Ganges or

Mr. Markham.

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[1] Tibet, p. xxiii., 1876.

the Brahmaputra." The southern chain is made up of the series of snowy peaks which, to the east, overhang Nepál, Sikkim, and Bhután. Thus, Mr. Markham is at one with Mr. Saunders in his theory as to the Himálayan system, only substituting the terms "inner or northern, central and outer or southern," for the terms "Gangri, northern and southern Himálaya," used by Mr. Saunders.

Calcutta Review.

A writer in the *Calcutta Review*[1] has taken objection to the orcation of the southern chain, which, "being occasionally intersected by rivers of more remote origin, is not a chain at all, but a series of spurs running southwards from an extended line of elevation more to the north, in the neighbourhood of which the said rivers rise." He also suggests for the whole system the name Indo-Tibetan, correctly urging that it is undesirable to give to the whole a name which belongs only to a part. He prefers simply to lay down two lines of watersheds, the northern corresponding for the most part with Mr. Markham's inner range, and the southern extending from Chulás by the Zoji-la, Baralacha, Níti, and No passes to the Laghalangla above Shikatse. He then examines the river basins and shows that Hodgson's theory regarding them is in accordance with facts; that these basins derive much of their water from certain prominent peaks which, standing in advance—that is, southwards of the watershed—are connected with it, and from which ridges with dependent spurs project, that serve as lateral barriers to the basins. "The preponderating synclinal slopes of the ridges and spurs which overrule the effect of all other intervening inequalities of surface, however vast, cause the several groups of mountain streams between them to converge till they unite and constitute a main river near the edge of the plains." This is practically Hodgson's law re-affirmed in the full light of all that modern research has shown us regarding the geography of Tibet, the Kárakoram and Káshgar, a *terra incognita* to our early writers.

Rejoinders of Mr. Markham and Mr Saunders.

Both Mr. Markham and Mr. Saunders have issued rejoinders to the criticisms in the *Calcutta Review* in two articles in the *Geographical Magazine*.[2]

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[1] January, 1877, p. 145.

[2] By Mr. C. R Markham in May, 1877, and Mr. Saunders in July, 1877, Geo. Mag IV, 113, 173, London. The other matters in controversy between the reviewer and Mr. Markham are omitted as foreign to the subject of this notice.

Mr. Markham chiefly confines himself to a defence of his use of the word 'chain' as applied to a series of culminating ridges, whether rivers force their way through its gorges or not; but Mr. Saunders goes more fully into the entire question at issue between him and the reviewer, and supports his arguments by a re-statement of his views on the physical geography of the entire Himálaya-Tibetan system. For this purpose he draws largely on his "Sketch of the Mountains and River Basins of India," already noticed, in which the theory of the southern chain of snowy peaks was first developed; and whether we agree with his deductions or not, we must consider his summary as a valuable contribution to our knowledge of the subject. He recapitulates the arguments in favour of considering the line of snowy peaks a southern chain, and concludes that they are entitled to that name, "(1) as the culminating summit of the southern or Indian slope; (2) as the common origin of a succession of rivers; (3) as cut off from the northern range by a succession of remarkable valleys, sometimes very long, sometimes very deep, and sometimes very broad and flat, and all containing considerable rivers running parallel to the chains which they divide." He objects to the inclusion of the mountain ranges on both sides of the troughs of the Indus and Sanpu under the term Himálaya, the northern watershed of those rivers composing the contreforts, buttresses and slopes or escarpments of the great central plateau which they uphold and from which they cannot be separated. The table-land is Tibetan; therefore its southern slope cannot be called Himálayan. The remaining portion of Mr. Saunders' article will be noticed as we proceed.

Mr Blanford.

The latest contribution to the physical geography of the Himálaya is to be found in Mr. H. Blanford's Manual[1] and Mr. W. Blanford's introduction[2] to the "Manual of the Geology of India." In the latter work, which may presumably be taken as giving Mr. W. Blanford's conclusions on the subject, he considers the Himálaya to form a curved belt of mountains with their convexity to the southward which mark the southern scarp of the Tibetan plateau as the

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[1] Physical Geography for the use of Indian Schools, Calcutta. [2] Calcutta, 1879, I., ix. It should be remembered that the term 'range', is used here for geological purposes which are not always the same as those intended by geographers. Its precise meaning depends on the context.

Kuen-lun define the northern. The western terminal portion of the Himálayan chain comprises a number of great ranges variously named. It is doubtful whether any of these "should be considered the prolongation of the main Himálayan axis, although, if any be really a continuation of the Himálaya proper, it is either the Pir Panjal or the Zanskar range." Geological considerations would lead him to suppose that "the main range commences on the westward in the Dhauradhar near Dalhousie, and extends to the east-south-east till it rises into the main snowy range of the north-west Himálaya. Many geographers distinguish two parallel ranges from the neighbourhood of Simla to the eastward; the snowy range proper, formed of the highest peaks (Saunders' theory), and a more northern ridge, forming the watershed between the Tibetan plain and the rivers running to the plains of India. Others consider the latter to be the true Himálayan range, and look on the higher peaks as belonging to the spurs between the rivers flowing from that range. It is certain that the great peaks, such as Nandadevi, &c., are separated from each other by deep valleys, through which flow streams coming from the northern range, and that, although the peaks of the latter are inferior in elevation, the passes by which it is traversed are much higher; but it has not yet been ascertained whether the great peaks are on the strike of any continuous band of rock, or whether they merely consist of hard nuclei left undenuded." There is little doubt that, until the geologist is able to assist us, the question whether the line of snowy peaks should be considered a true chain or merely spurs from the main water-parting must be left undecided. Though year by year fresh materials are added to our stock of knowledge regarding the Himálaya, they are yet too imperfect for us to offer little more than a suggestion as to the views that should be adopted regarding its structure. A glance at Mr. Saunders' map will show us the vastness of the subject, and that the Himálaya of Kumaon and Garhwál, with which we are more immediately concerned, is but a very small portion of the great girdle of snowy peaks that uphold between them the elevated plateau of Tibet. Herbert showed us that this girdle, as seen from the plains of India, is not a continuous line of parallel ranges rising one behind the other, and increasing in elevation until the series is closed in the farthest distance by the line of snow-clad peaks; but that these peaks or groups of peaks are ramifications from the line of water-parting which itself is lower than the line of greatest elevation. Hodgson subsequently explained the influence of these groups of peaks on the river-systems, and Captain Strachey showed us that the Himálaya was the southern slope of the Tibetan plateau as the Kuen-lun formed its northern slope. These are, broadly, the more important additions to our knowledge of the physical geography of the Himálaya that have been made of late years. To our mind the recognition of the unity of the entire Himálaya-Tibetan system is the most important of them all, and that alone which will lead to practical results. The division of the *Himálaya into ranges may be allowed as a matter of convenience, but* should not be permitted to cloud the great fact that all are but variations in the southern slope of the great table-land due to the influence of the elements on the materials of which they are composed, and to the disturbing action of subterranean forces. We can lay down the line of water-parting and the line of greatest elevation with some precision, but must call in the aid of the geologist and mineralogist to distinguish which amongst the ranges is entitled to be called the real main axis of the Himálaya; and, until their labours are communicated to the world, must rest content with the somewhat arbitrary distinctions afforded by the prominence or otherwise of existing physical features.

Nomenclature.

Seeing the misunderstandings that have arisen from a too loose use of words and phrases, it will be as well to state here that we adopt the word 'water-parting' to represent the ridge which separates the flow of water on either side of a range of hills.[1] The word 'range' will include a series of mountains or hills continuing in one direction along a common axis, whether broken by chasms or not; and the word 'spur' will be used of a ramification from a range, whether connecting it with another range or sinking gradually into a plain.

The great mountain chain lying between Tibet and the plains of India is generally known to the natives of India by the term *pahár* (mountain), to which they prefix the local name where such exists.

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[1] The use of this word in this sense is one of the subjects of controversy between the Calcutta reviewer and Mr. Markham. The former (p. 147, note) objects that the old word 'water-shed' is sufficient.

The more educated give the name Himáchal[1] (snowy-range) or Himálaya (abode of snow) to the snow-covered ranges; whilst Europeans popularly include under the name Himálaya the entire mountainous region lying between the gorge of the Brahmaputra on the east and that of the Indus on the west, and between the upper valleys of the same rivers on the north and the plains of India on the south. A first glance at any good map will convince us of the general unity of the physical relations of the range within the limits commonly assigned to the Himálaya, whilst a closer examination will induce us to include much more. For our part we accept the popular definition of the Himálaya as extending from the gorge of the Indus on the west to that of the Brahmaputra on the east, and from the upper courses of the main branches of those rivers on the north to the plains of India on the south, speaking of its connections beyond those limits as the western and eastern extensions respectively.

Ethnical sketch.

It will materially aid the reader if we further preface our remarks with a short description of the ethnical and political divisions of its surface, and of the regions in immediate contact with it. We have arrived at some idea of the physical relations of the tract itself, and shall now, at the risk of being thought diffuse, endeavour to trace the ethnical affinities of its inhabitants. Commencing, then, with the plain on the south, we find the provinces of British India flanking the foot of the Himálaya along its entire length from the 96th to the 72nd meridian of east longitude. Following the direction of the Himálaya from east to west, we find in Upper Asám a number of tribes speaking different languages and dialects, and so intermixed and blending the one into the other that, beyond a mere cursory description, their classification cannot be attempted here. In the extreme north-east they are allied with or are members of the tribes inhabiting the neighbouring hills, of whom more will be said hereafter. They speak a language having an affinity with the great Barma-Tibetan group, and are mere pagan savages. Along either side of the Brahmaputra in its course through the valley we find the settled tribes of Asám speaking a language akin to Bengáli. Though differences exist they so closely resemble in habits and character the people of the conterminous parts of Bengal that it is difficult to draw a strict line of severance between them without entering into long historical and ethnical discussions quite out of place here: many that are now Hindu or Musalmán Bengális in all outward appearance can be shown to be converts in recent times from the pagan tribes in their neighbourhood of unmistakably aboriginal origin. The people of Bengal, the flat alluvial plains of which lie along the lower courses of the Ganges and Brahmaputra, exhibit all the features characteristic of a race inhabiting a region of tropical heat and moisture. They are small in stature, of dark complexion, and effeminate in character, living chiefly on rice grown in the lowlands subject to annual inundation. Their dress is of the scantiest proportions, consisting chiefly of one or two pieces of cotton cloth simply wrapped around their waist and shoulders, and not wrought into any form of garment. Their heads and feet are usually left bare. Their houses, constructed of mats, lie scattered amongst the thick groves of bambus and palms that spring up in wild luxuriance on the uncultivated ground.

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[1] The word Himáchal (हिमाचल) is derived from two Sanskrit words, '*hima*' (snow) and '*achala*' (mountain), meaning 'snowy-mountain' or 'snowy-range. Similarly the word Himálaya (हिमालय) is derived from '*hima*' and '*alaya*' (abode), meaning the 'home' or 'abode of snow.' The proper pronunciation is therefore Him-á-lay-a, *not* Him-a-láy-a as commonly obtains. The plains-men speak of the Simla-*pahár*, the Mansuri-*pahár*, and sometimes of the snowy-range as the *barf* (ice)-*pahár*. "The people south of the Himálaya in Nepál call all snowy mountains *langar*, by which they mean the highest points. They call the peaks that have no snow *banjang*, and the low ground under the said *banjang* they call *phedi*. The term Himálaya is not used by uneducated people, who only talk of the snowy mountains as '*barfáni langar*.'—*G. T. S. Rep.*, 1872, p. 40.

Plains of Asám and Bengal.

As we ascend the Ganges,[1] we find a drier climate with greater contrasts between the summer and winter temperature, and a taller, more manly, and more robust race, of whose food the millets and unleavened bread of wheat, barley, and other grains form the principal element. Their clothing is more elaborate and warmer than that of the Bengáli. All wear turbans, and those who can afford it have short jackets fastening on the right breast in the case of Hindús, and on the left breast in the case of Musalmáns. Their houses are built of mud and are either

Plains of Upper India.

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[1] This account of the Hindús in the plains is partly based on Elphinstone and Notes by General R. Strachey.

tiled or thatched in the villages, but in many of the towns very small bricks are used in the construction of the better class of dwellings. The country is open and unenclosed, and almost the only trees are groves planted near towns and villages, with occasional patches of *dhák (Butea frondosa)* and *babul (Acacia arabica)* jungle. The people are mostly Hindu in religion and speak dialects of Hindi. On approaching the Satlaj the language passes into Panjábi, also Sanskritic in its character, and we find the religion of the Sikhs the seal of the double dispensation of Brahma and Muhammad.[1] To the west of the Panjáb, or country of the five rivers, the religion of Islám predominates amongst a motley group of tribes of very varied origin. The name Hindustán, which is more correctly applied to the northern Gangetic districts alone, may without impropriety be used so as to include the entire tract below the Himálaya. Intersected by the innumerable streams that flow from the mountains above it, watered by the copious falls of periodical rains, and enjoying a semi-tropical climate, the great unbroken plain is thus supplied with the two great requisites, heat and moisture, that are the necessary and certain agents for the development of vegetable life. We naturally, therefore, find an agricultural population often in the older settled parts extremely dense, and attaining to no small degree of civilisation. Cities and large towns are common, many with a population of over 50,000 souls; and the inhabitants, without coming up to a European standard, enjoy considerable wealth. Literature, both indigenous and of European origin, is cultivated; schools are numerous, and the useful arts are highly advanced and eagerly followed. The hot climate which induces a love of repose and fertility of soil which renders severe labour unnecessary has, in some measure, modified the habits of patient industry which are usually characteristic of an agricultural population; but the dislike to change which marks those communities in all parts of the civilised world is nowhere more strikingly exhibited than in Hindustán. The great wealth of the country and its open and easily accessible character, together with the insuperable obstacles to union presented by differences in race and caste, have, for many centuries, subjected it to the reiterated attacks of foreigners. With very few exceptions all truly national government has ceased to exist; and from what little we know regarding it, the people have small cause to regret the successive changes of masters. India has never had in the whole course of its history so strong, universal, and just a government as it has enjoyed under the British since the memorable mutiny of 1857. Englishmen may well point with just pride to the lengthy catalogue of measures attesting true moral and material progress that have been introduced during the last quarter of a century, and have been assimilated by the people to such a degree that the advance —political, moral, and social—made has eclipsed all that had been previously effected under British rule.

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[1] Cunningham, History of the Sikhs, p. 13.

Clothing, food, customs.

Taking the people of the plains as a whole, their clothing is cotton and their food is vegetable, though Musalmáns and some Hindús eat meat and a few eat fish. The dress of the men, as a rule, is white, though they often wear coloured jackets ; the women, who have no other covering for their heads than a corner of the cloth that they wrap round their bodies, frequently wear bright colours, usually indigo blue, Turkey red, or safflower yellow. The Hindús preserve their moustache, but shave their beards, and frequently their heads, except a small scalp-lock, whilst the Musalmáns allow their beards to grow. The seclusion of women seems to be a custom introduced by the Muhammadans, but amongst all religions and races in Hindustán the position of females is essentially inferior to that of the other sex, with whom they do not mix in society. Marriages are almost always contracted in childhood, and the betrothed bride is always under the age of puberty. Amongst Hindús, a dowry is given with the daughter, though the practice of accepting a sum of money for a daughter is in many parts of the country gaining ground. Female infanticide has been rife in the Gangetic districts of Upper India, due to the disgrace supposed to be attached to the expression 'father-in-law,' as well as to the great expenses ordinarily consequent on the marriage of a daughter. The education of women is absolutely neglected, and the efforts of Government in this direction have proved a total failure. The men, however, for the most part, amongst the classes above those actually engaged in the cultivation of the soil, can read and write, and even the men who have not acquired those attainments possess the power of mental calculation to a remarkable degree. The Brahmanical faith is with few exceptions dominant throughout Hindustán. The Musalmáns are, however, numerous everywhere, and in some districts are in the majority. They belong chiefly to the Suni sect, but Shiahs are also found in certain tracts where the influence of powerful families of their persuasion has been felt. The peculiar modification of Hinduism adopted by the Sikhs is chiefly confined to that portion of the Panjáb which lies east of the Chínáb. To the west of that river, the great mass of the population is Muhammadan. Taking the people of the Panjáb proper, excluding Peshawar and the trans-Indus districts attached to the Leia and Multán divisions, we have a population of ten millions, of whom seven-twelfths are Musalmáns, four-twelfths are Hindús, and one-twelfth are Sikhs. Distributing them according to race, General Cunningham[1] makes 3 per cent. of so-called early Turanian origin, 27 per cent. Aryans, and 70 per cent. later Turanians.

Eastern Himálaya.

We shall now consider the ethnical and political divisions of the Himálaya itself, proceeding in the same direction from east to west. At the extreme east we have the same races speaking a Barma-Tibetan language that we found in the plains, but a line drawn north and south across the Brahmaputra, in the general direction of the Dhansiri river, and continued southwards so as to leave Kachár to the west of it, would, according to Hodgson, divide them from the Alpine races of more pronounced Tibetan stock, as well as from the so-called aboriginal tribes of the central Himálaya. These Barma-Tibetan tribes are known as Abors, Bor-Abors, Daphlas, Akas, Mishmis, Miris, &c., and their communities are reported to have a sort of rough republican constitution. This conjecture of Hodgson appears to be supported by the result of the most recent investigations.

Eastern tribes.

The country lying on the Táwáng route by the Dhansíri river from Asám to Chetang in the valley of the Sanpu, in the 92nd meridian of east longitude, has been traversed by one of the Pandits of the Great Trigonometrical Survey, from whom we learn that to the east of that line the Himálaya is inhabited by Lhoba Daphla tribes.[2] These men are remarkable for the abnormal development of the muscles of the arms and calves of the legs. They wear cylindrical-shaped hats made of bambus, and their only garment is a long blanket folded somewhat after the fashion of a plaid and fastened round the waist by a cloth girdle, which is used as a quiver for their arrows, which all carry, as well as a bow slung over their left shoulder. The greater part of their legs and arms is bare. They wear no boots, but ornamental rings made of rope, fastened very tightly both on the wrists and legs below the knee. They have a decided Tibetañ caste of feature, high cheek-bones, and Chinese-looking eyes. They wear no hair on the face, but the hair of the head is allowed to grow to a great length, and is drawn together behind the head and then allowed to hang down.[1] They appear to be distributable into two groups—those living in the great rice country to the north on the banks of the Sanpu, called Lho-khâls, and who are independent of the Lhása authorities; and the Shiyár Lhobas, a wild race who inhabit the country through which the great river flows to Gaya, Asám, and who may be identified with the wilder tribes of Mishmis. The Mishmis are distributed into three great divisions comprising numerous clans—the Chúlikáta or crop haired, the Midhu, and the Digáru, each of whom have a separate dialect, and the last reside within British territory along the hills as far west as the Digáru river. The Abors or Pádams inhabit the country to the west of the Dibong river. They are described by their neighbours as exceedingly fierce and blood-thirsty: "like tigers, two cannot dwell in the same den. Their houses are scattered singly or in groups of two and three over the immense extent of mountains inhabited by them." They manufacture the weapon called *dao*, and weave coarse cloth, which with *manjít*, beads, bell-metal cooking vessels, female slaves or rather wives, and the breed of cattle called *mithans*, are exchanged for salt and coarse cloth imported by the Miris from the plains. The Miris are more civilised than the Abors, and dwell in villages both in the hills and plains. The Akas or Hrussos live between the Miris and the Daphlas on the upper waters of the Sundari, and call themselves Tenae. The women of the Akas wear blue or black petticoats and jackets of white cotton of their own manufacture. Their faces are tattooed, whence the name "Aka" given them by the people of Asám. The males wear a girdle of canework painted red, which hangs down behind in a long bushy tail. Their staple food is rice, but everything edible is made use of. The

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[1] Cunningham's Arch. Rep., II, 2, 4.

[2] See section A, of references attached to this chapter.

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[1] G. T. S., 1873, p. 70.

Daphlas belong to the same stock, and all are mere pagan savages, debased, cruel, and treacherous, though in the last respect the Akas have a somewhat favourable report.

Tribes of the southern water-shed.

To complete our review, we shall diverge to the south of the Brahmaputra and briefly notice the tribes inhabiting its southern water-shed.[1] In the extreme east we find the Khamtis or Shans, a tribe linguistically allied to the Siamese and Buddhists in religion; next we have the Singphos, or Kakhyens, and the Jilis, on the northern slopes of the Patkoi range, both of whom are pagans and speak a language intermediate between Barmese and Tibetan. Further west come the Nágas, who are distributed into three great classes—the Namsang, Khari, and Angámi. They are the most numerous of all the pagan tribes to the south of the Brahmaputra, extending from the Kopili river in the meridian of Nowgong on the west to the meridian of Sadiya on the east. They bury their dead and appear to manage their affairs in a sort of republican assembly. The Kopili river separates the Nágas from the Khasiyas of the Jaintiya and Khasiya hills around Shillong. The Khasiyas appear to be an isolated group, speaking a monosyllabic language which cannot be classed with any other of the same family. The form of government is republican and the religion is mere paganism. To the west are the Gáros, who also are pagans, though their language has affinities with the Aryan dialects spoken on the north, south, and west. The language, however, has a Tibetan basis, and Hodgson would include it in the Bodo group, of which more hereafter. South-west of the Nágas come the tribes of the Manipur, Lusháí, Tipura (Tipperah), and Chittagong hills. From McCulloch and Damant we learn that there are numerous dialects in Manipur, and that the principal has a character of its own derived from the Nágari. The inhabitants have adopted the Brahmanical faith. The people further west are known as Kúkis, and appear to speak four dialects of a common stem-language:—the Lusháí spoken by the Dzos of the Lusháí highland, the Thadu in northern Kachár, the Kúki in the same district, and the Hallámi in the Tipura hills. The Kúkis are pagans, but are gradually yielding to the influence of their Brahmanical neighbours, as indeed are all the pagan tribes similarly situated in the Asám valley. We shall now return again to the tribes inhabiting the Himálaya to the west of the Dhansiri river.

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[1] See section D. of references attached to this chapter.

Táwáng

The whole country along the Táwáng route from Asám to the head of the valley leading down to Chetang on the Sanpu is under the rule of the Lhásan Jongpen of the Chona Jang. The Lámas of the great lamasery of Táwáng, however, own the country to the south of the range of hills which form the water-parting between the Táwáng and Dhirang valleys, and are entirely independent of Lhása. They manage all public business in an assembly of the principal Lámas, called the *Kato*, which is also the supreme court of justice. To the north, near the Chetang valley, the elevated highlands are occupied by nomad tribes; but to the south, in the Mon-yul or Sub-Himálaya, the country within which Táwáng is situated, the people are called Monpas or Hill Indians, and differ materially in language, dress, and manners from the Bodpas, or people of Bod-yul to the north of Chona. The Monpas resemble the inhabitants of Bhután on the west. They wear their hair closely cut round the head, not in plaited tails as in Tibet, and as a covering have a small skull-cap of woollen cloth or felt. Instead of the long gown of Tibet a short coat is worn which reaches to the knee, and is fastened by a woollen girdle that invariably holds a long, straight knife. The people keep cattle, sheep, and pigs. Thus, the line drawn north and south by the Dhansiri river passes through this wedge of Tibetan territory, separating the Barma-Tibetan tribes on the east from those who have a more pronounced Tibetan origin in the central Himálaya and the so-called aboriginal tribes of the lower Himálaya on the west. Hodgson assigns to the latter the name Tamulian, but it cannot stand, involving as it does linguistic and ethnical associations which modern research has failed to establish.

Bhután, Sikkim.

To the west of the Dhansiri river we have the countries of Bhután, Sikkim, and Nepál, all of which possess a more or less established form of government.[1] Much has been written regarding the people inhabiting those countries which we can but very lightly touch upon here. The entire tract may be divided into three great belts,—the elevated region beyond the snowy range that is visible from the plains, varying from 10,000 to 16,000 feet above the level of the sea; the central region, varying from 4,000 to 10,000 feet; and the lower region, extending from the plains to 4,000 feet.[1] To the central region are confined the Lhopás, Lepchás, Limbus, Kirántis, Murmis, Newars, Sunwárs, Chepángs, Gurungs, Magars, and Khasiyas. To the lower regions belong the Koch, Bodo, Dhimál, Kichak, Tháru, Denwar, and Pallah tribes. The inhabitants of the central region belong to a comparatively recent Tibetan immigration, whilst those of the lower region, the so-called Tamulian aborigines, are apparently to be ascribed partly to an early Tibetan immigration and partly to an Aryan source. To the north, along the entire line of gháts from the 92nd meridian to the Jumna, we find the Bhotiyas or Bod-pas of pure Tibetan origin and Buddhists in religion. Bhután, the Lho-pato, Lho-duk, or Lho-mon of the Tibetans, is also a Buddhist country, as well as Sikkim, the Demojong of the Tibetans. Nepál, called Palbo by the Tibetans, is partly Buddhist and partly Brahmanical in religion. In the central Himálaya of Bhután and Sikkim we find the Lhopás, Lepchás, and Limbus. The name 'Lhopa' seems to be a generic term signifying the people of Lho or Bhután, as 'Bod-pa' means a person of Bod or central Tibet, and 'Kham-pa,' a person of Kham or eastern Tibet. So also the term 'Dok-pa' is the religious equivalent of the territorial term 'Lho-pa.' The Lepchás extend from Panákha in mid-Bhután on the east into eastern Nepál on the west. They are divided into the Rong and Khamba tribes. The women of both divisions wear a loose coat of the fibre of the silk-worm that feeds on the castor plant, or of unbleached cotton with a wrapper of the same material around the waist to form a petticoat. The men wear a robe of striped red and white cotton cloth crossed over the breast and shoulders and descending to the calf of the leg, leaving the arms bare; a loose jacket of red cotton cloth is worn over the robe by those who can afford it, and both are bound round the waist by a red girdle. Some strings of coloured beads round the neck, silver and coral earrings, a bambu bow with a quiver of iron-pointed arrows, and a long knife complete their costume. This knife, called '*bán*' by the Lepchás and '*chipsa*' by the Bhotiyas, is worn on the right side, suspended from the left shoulder, and serves as an axe, hoe, spade, sword, and knife. The Lepchás eat any flesh of bird or beast, all cultivated and many wild grains, and drink beer and tea. They are Buddhists in religion. Their language, though allied to Tibetan, is not Tibetan, and has a character of its own. They bury their dead; though the Murmis, a tribe of the same country, first burn their dead and then bury the ashes. The Lepchás are short in stature, averaging about five feet, bulky for their height, and rather fleshy than sinewy. They have a fair complexion, pleasantly marked Tibetan features, and part their hair along the crown of the head. Both sexes allow it to grow long; the younger males allow it to hang loose over the shoulders, whilst the elder males and women plait it into tails, and the latter tie the ends with braid and silken cords and tassels. Like all Buddhist hill-tribes they are very filthy in their habits, ablution being unknown.

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[1] See section C. of references attached to this chapter.

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[1] Better known as Hodgson's belts.

Limbus.

The Limbus are an important tribe of the central Himálaya, found between the Tista on the east and the Dúdh-Kosi on the west. The word 'Limbu,' according to Dr. Campbell, is a corruption of the term 'Ekthumba,' the correct name of this people, and used generally to designate the whole population of this portion of the Himálaya not included amongst the well-known divisions, such as Lepchás, Murmis, Bhotiyas, and Parbatiyas. Under the name Limbu are included the Kirántis or Kirátis, Ekas, and Ráis, and their country is divided into Kiráti-des from Dúdh-Kosi to the Arun and Limbua from the Arun to the Konki river, which leaves the Nepál hills about twenty miles to the west of the Mechi river. Further east and west they occur only in small colonies. Hodgson records the vocabulary of seventeen dialects of the Kiráti language, none of which are referable to the written Tibetan or Hindi. They are pagans in religion, though willing to pass themselves off as followers of Hinduism or Buddhists where those religions prevail. Their features, the absence of a beard, and the colour of their skin, all show them to be of Tibetan origin. The Limbu wears his hair long, but does not plait it; he carries a *kukhri* or curved knife instead of the *ban*, and has a wide trousers and jacket instead of the robe and long jacket of the Lepcha. Both tribes are found at elevations of from 2,000 to 4,000 feet above the level of the sea.

Nepál.

The Hayus or Vahus prefer the lowest elevations in the valleys, and occupy the central and lower ranges of the mountains of eastern Nepál between the Arun river and the Konki. They are found mixed with the Eka division of the Limbus, but possess clearances and villages of their own. They differ from all around in language, religion, and habits, and are esteemed an outcast race by the Gurkhális. They do not intermarry or hold intercourse with other tribes. The Bramhus, similarly placed in the Noakot valley to the west, speak a Barma-Tibetan dialect and are also pagans. The great bulk of the Murmis are found between the Nepál valley and the Dúdh-Kosi, whence in smaller numbers they extend to the Tísta on the east and as far as twenty miles west of Kathmandu on the west. They are divided into two classes: one from the Ni district in Tibet, and the other from the Tsang district; hence the generic name Nitsang or Nishang applied to the whole tribe. They prefer elevations of from 4,000 to 6,000 feet and engage in pastoral and agricultural operations, living in cottages built of stone and thatched with grass. They are Buddhists in religion and their language is akin to Tibetan. In their physical traits they resemble the Lepchás, though somewhat taller. The Newars compose the majority of the inhabitants of the Nepál valley, but are not numerous beyond its limits. They are a shorter race than the Gurkhális, and their appearance betrays their transmontane origin. The greater number are Buddhists, and the remainder profess the Brahmanical faith. They possess a written character of their own and speak a distinct dialect, though the Buddhist portion also use Tibetan, in which their religious books are chiefly written. In the forests to the west of Nepál, close to the plains, we have the wild tribes known as Chepángs and Kusundas, the former clearly akin to the Rájis of Kumaon. They speak a language allied to that of the Lhopás of Bhután. In the same direction are the Hinduised tribes of Khasiya, Magars and Gurungs, generically known as Parbatiyas. They speak a language having a Tibetan basis, and into which many Hindi and Urdu vocables have been introduced. The Gurungs, like the Murmis, prefer elevations of 6,000 feet, and are partly pagan and partly Hindu in religion. The Magars are entirely Hindu in religion, and to them belong the Thápa clan so famous in later Nepálese history. Both these tribes supply numerous recruits to the regiments in the British service, and to this is probably due the Indianised form of their speech. North of them we find the Sunwárs, and on the west the Thaksyas (Thakuris ?), and on the east the Pahris. Vocabularies of the languages of these tribes have been preserved by Hodgson.

The Gurkhális speak the Hindi dialect called Nepálese Khas, or Parbatiya. In summer they wear a sort of pantaloons called *páejámas* and a jacket or coat of white or blue cotton, and in the winter the same padded with cotton or lined with fur and fastened by a cotton girdle, which invariably holds the heavy, crooked knife, called *kukhri.* Turbans of dark cloth or loosely-folded cotton are used as a head-dress, or small tinsel, embroidered skull-caps. The Newárs wear a waist-cloth of cotton and a jacket of the same, or some woollen materials. Some adopt the Tibetan costume of full short trousers, a long tunic, and a fur-edged cap. The head-dress is a small skull-cap of black or white cloth thinly wadded with cotton and generally turned up an inch or so at the border. The dress of the other inhabitants of Nepál differ little from that already described. The women of the Newárs wear their hair gathered into a short thick club at the crown of the head, whilst others have it plaited into a long tail. Flesh is much more commonly used by all classes than in the plains. The lower classes drink a coarse fermented stimulant called *rakshi,* and the higher classes, when they can afford it, consume large quantities of tea.

Tribes of the lower Himálaya.

Taking now the tribes inhabiting the lower Himálaya to the north of the Brahmaputra, we find on the extreme east the Deoriya Chutiya, the remnants of a powerful tribe, who though Hinduised in religion preserve their old language, which is affined to the Barma-Tibetan group. Next come the Dhimál, Kachári or Bodo, and the Koch. Hodgson tells us that in travelling between Gwálpára in Asám and Aliganj in the Morang Tarái of Nepál one has to pass through the country of the following tribes :—the Koch, Bodo, Dhimál, Rábha, Hájong, Kúdi, Batar or Bor, Kebrat, Pallah, *Gangai, Maráhi, and Dhanuk. The Rábha, Kúdi, Hájong, Mech,* Gáro, and Páni-koch, are all affined to the Kachári or Bodo type. The last six of Hodgson's list are doubtful and undefined and require further investigation. The Dhimáls are found in the *sál* forest between the Konki and the Tarsa, mixed with the Bodos, but without intermarriage and living in separate villages. The Bodos extend from the Surma to the Dhansiri, and thence by Bijni and the Bhután and Sikkim Tarái to the Konki; besides occupying outside the forest limits a large proportion of central and lower Asám.[1] The Rábhás and Hájongs are found in the Gwálpára district and are Hindús, whilst the Páni-koch occupy the tract along the foot of the Gáro hills and are still pagans. The Dhimáls and some of the Bodos, Kochs, and Mechis are still pagans. The last-mentioned tribe is found all along the Tarái with the Kochs and Dhimáls. Their dialect and religion differ from those of the neighbouring tribes of the hills and plains. They are fairer than the Kochs and have strongly marked Mongolian features, but softer than those of the Lepcha or Limbu, resembling more the Newárs than the other hill-tribes of Tibetan origin. They live at elevations between 800 and 1,000 feet, and almost always keep to the forest, where they make temporary clearances. Their religion is connected with the Bhairava form of Sivaism. The Koch tribe is now nearly completely converted to Islám or Brahmanism, and with their conversion have dropped their old name and language, speaking a corrupted form of Bengáli, in which, however, many of the ancient vocables are retained. The Páni-koch, according to Hodgson, represents the unimproved primitive Koch stock; but Dalton considers them a plains tribe driven upwards by the Aryan invader. Hodgson estimates the number of all religions at over a million souls. The settled Koch assimilate in their food and clothing with the Bengális, and show no marked differences. The Bodo women wear garments of coarse silk, the produce of the worm that feeds on the castor-plant. The Bodo men and Dhimáls of both sexes wear cotton clothes. The men wear one cloth thrown over the shoulders and another wrapped round the waist and drawn up between the legs. The female garment consists of a cloth wrapped around the body and enveloping it from the arm-pits to the centre of the calves. Wooden sandals are worn, but ornaments are rare, though the women sometimes wear small silver rings in their noses and ears and heavy bracelets of mixed metal. Meat, fish, and vegetables are eaten by all, and beer made of rice or millet is a favourite beverage. Thárus and Denwars are found westwards in Nepál mixed with the Mechis, and especially the former in the malarious tract in the Gorakhpur and Tirhút Taráis along the foot of the mountains where no other human being can live. They, however, seem to be healthy, robust races.

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[1] See Hodgson's Aborigines of India, p. 151.

Karnáli to the Tons.

The mass of the people of the Doti district of Nepál and the British district of Kumaon belong to the race generically known as Khasas or Khasiyas. In Garhwál they are more mixed, though the difference is scarcely discoverable. The northern inter-Alpine valleys are, however, inhabited by Bhotiyas, who are decidedly of Tibetan origin. Amongst the Khasiyas there is a great admixture of immigrants from the plains, and most of the better classes look down with contempt on the purer members of the Khasiya class, who appear to represent the oldest inhabitants of these hills, though now much modified by centuries of close connection and intermarriage with the more civilized tribes of the plains. Throughout Kumaon, the Kyunam of the Tibetans, the inhabitants dress and eat like those of the plains, the only difference being that to the north woollen materials find more favour, and there is greater license in matters of food and drink. In Garhwál, which is known as Galdiya to the Tibetans and to the north as Chongsa, garments made of hempen fibre are common amongst the poorer classes. The language spoken throughout is pure Hindi, though for purposes of trade the Bhotiyas also use Tibetan, and amongst themselves speak a dialect of Tibetan origin. In the land of marsh and forests which borders the plains we find the Thárus in the eastern Tarái and the Bhuksas, a tribe of similar character, occupying the tract between Puranpur-Sabna in the Bareilly district and Chandpur in the Bijnor district. The Rájis in eastern Kumaon are akin to the Chepángs of Nepál, and the Láls and Rawats of the same tract are now absorbed in the Hinduised population.

Bisahr.

To the west of the Tons we have a number of petty independent states known as the "protected hill-states," followed by British territory. Amongst the former the most important is Bisahr,[1] of which the northern part, called Kunawar, or more correctly Knaor, the Kunu of the Tibetans, marches with Tibet. The people of upper Knaor are of Tibetan origin and Buddhists in religion, and correspond to the Bhotiyas further east. Buddhism extends down the valley of the Satlaj as far as Sarahan, between which and Pangi is a sort of debateable ground common to Hindús and Buddhists; but north of Pangi Buddhism prevails, and south of Sarahan, Hinduism. With our approach to these Buddhist countries the curious custom of polyandry appears. Commencing in north-western Tihri, we trace it through Bisahr and Láhul, but find it confined to the inhabitants of the valleys of the central and higher ranges professing both the Buddhist and Hindu religions. The central tract is inhabited by a fair, slight, and muscular race of mixed origin known as Kunets, and akin to the Khasiyas on the east. To the south, in the portion adjoining the plains, the people resemble the inhabitants of the lower country, and appear of every shade of colour from dark-brown to a tawny yellow or yellowish-white. The hair is black and worn long at the sides and back of the head down about the ears, where it is cut short. The crown of the head is shaved bare, but moustache and beards are worn. The dress is a short coat of coarse cotton reaching to the knee, pleated in folds to give it fulness, and fastened round the waist by a girdle of the same material. A pair of cotton *páejámas* and a sheet of the same material complete the hot-weather costume. In winter these are exchanged for a pair of woollen drawers and a blanket, but the poorer classes remain content with a coarse waist-cloth and a blanket all the year round. The food of the people from the Káli to the Indus differs very little in each tract, or, indeed, from that of the people in the adjoining plains. Wheat, barley, rice, and various millets and pulses are grown in the lower hills, and to the north hardier varieties suited to a sub-arctic climate are cultivated. When the produce is insufficient for the wants of the inhabitants, a supply is imported from the lower districts. To the north, woollen home-spun replaces the cotton worn in the lower hills, and the girdle supports an axe. The women wear a similar dress, the coat reaching down to the ancles, and the hair, done up in long plaits, is twisted into rolls and covered with a piece of cloth wound like a turban round the head.

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[1] See section D. of references attached to this chapter.

Satlaj to the Indus.

To the west of the Satlaj we find the British territory of Kulu and Mandi, the independent state of Chamba, and the territories of Kashmír and Jamu.[1] Kulu, called in Tibetan Nyungti and Mandi, lies along the upper course of the Byás; Chamba, known to Tibetans as Panga, along the Rávi; and Láhul, the Tibetan Garzha, on the Upper Chináb. To the north in Láhul and Ladák the people are Bhotiyas or Bodpas of Tibetan origin, professing the Buddhist religion, and amongst them is a servile race known as Bem or 'low.' Further east in *Baltistan* are Tibetan Musalmáns who have adopted with their religion the Arabic alphabet. All these have decided Mongolian features, and are noted for their strength of body and power of enduring fatigue. In this respect the Baltis are somewhat inferior to their Buddhist brethren in race. The men wear a coat of woollen material reaching to the knees, fastened by a girdle, in which a knife is usually carried. Round their legs, from knee to ancle, they have coarse woollen leggings secured by a tape of the same material wound spirally round the leg from the ancle upwards. The head-dress is either a quilted skull-cap or a fur cap with the hair or wool inside, and with a large flap behind which covers the neck and ears. They wear boots of felt with soles of sheep or goat-skin. The women wear a black woollen jacket with a striped parti-coloured petticoat and baggy trousers, and over all a skin coat with the fur turned inside. The hair is arranged in a number of small plaits, and is ornamented by a band of cloth, on which is sown a number of turquoises and beads. The food of the common people consists of thick barley cakes, though those who can afford it eat wheaten bread and drink tea and a fermented liquor called *chang*. The name Kunet seems properly to designate only the mixed race in southern Knaor, but it is used for the population of the central tract in Bisahr, Kulu, Chamba, and Kashtwár, which borders on Ladák. In Chamba we find the Gaddis, who cross over into the neighbouring territory of Kashmír and meet the Thakars or Takkas, the chief cultivating class in those hills, and apparently in the same position with reference to other Hindús as the Játs of the plains. In the valley of Kashmír we have the Kashmíris, and amongst them the servile class called Bátal. To the south-west, along the left bank of the

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[1] See section E, of references attached to this chapter.

Jhelam, we have the Musalmán Dogras, called Chibhális, and the Musalmán Sadans of Púnch. On the right bank of the same river we have Musalmán Gakkars, Satis, and Dunds. To the east of the Chibhális come the Hindu Dogras, and amongst them the servile tribes of the Meghs and Dúms, who are scattered about everywhere and form a considerable part of the population. The Dogras have a light-brown complexion, clearly-cut features, and black hair, which is cut to form a fringe below the turban. The hair is worn on the face. The Thakars are a well-made race, somewhat more powerful in body than the Dogra Rajpúts, whilst the Meghs and Dúms are darker in colour, smaller in limb, shorter in stature, and less bearded. The food and clothing differ in no marked respect from that of the hill-tribes at a similar elevation to the east. Passing to the north-west of the Kashmír valley we come upon the Dárds, an Aryan tribe called Brokpa by the Tibetans, and most of whom are Musalmáns, though the Dah section have adopted the Buddhist religion, language, and customs. They occupy Astor and the trans-Indus Kashmíri district of Gilgit, as well as the neighbouring Kanjúd states of Nagar and Hanza, and the Kashkára states of Chitrál, Yassan, and Mastúj. They are a strongly-built race, with decidedly Aryan features, wearing woollen garments, except among the higher classes, who wear cotton in summer. The ordinary costume consists of trousers, a coat reaching to the knees and confined by a girdle, and a cap of woollen cloth about half a yard long and turned up at the edges until it fits the head, the outward roll thus forming a protection against heat and cold. On their feet they have scraps of leather put under, over, and around the foot, and kept in their place by straps of the same material wound around them. A servile race is also found amongst them, known as Dúms, and performing the same duties as the Dúms of Kumaon. To the south-west of Kashmír, in the salt range, we find the Awáns and Janjúhas, tribes of Aryan origin and of considerable antiquity. From the Káli to the Indus, dialects of Tibetan are spoken to the north. Mr. Drew tells[1] us that from near the Nunkun group of peaks which form the water-parting between the Maru-wadwan and Suru rivers, "and from no other spot in Asia, one may go westward through countries entirely

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[1] Northern Barrier of India, p. 20.

Muhammadan as far as Constantinople; eastward among none but Buddhists, to China; and southward over lands where the Hindu religion prevails, to the extremity of the Indian peninsula."

Afghánistán, &c.

Amongst the great mountain groups comprising the western or trans-Indus extension of the Himálaya, and including the ranges known as the Hindu Kush, Kára-koram, and those connecting them with the Tian-shán, are several petty states, regarding which much has been learned of late.[1] To the south lies the country called Afghánistán, the north-eastern portion of which is included in the western prolongation of the Himálaya, while the south-western part is a mountainous country confluent with the Himálaya on the one hand and extending far in the opposite direction to the table-land of Persia. To the north the boundaries are ill-defined and vary almost from decade to decade. The authority of the ruler of Kabul, in many places, depends on the forces at his disposal to coerce his unwilling subjects; but in 1879, the Afghán province of Turkistán included the whole of the countries between the Hindu Kush and the Oxus, comprising Balkh, Kunduz, and Badakshán, with their dependent states. The seat of the government is Balkh, with cantonments at Faizabad. Karátigin, on the upper valley of the Surkháb, pays tribute to Bukhára; also Darwáz, on the Panja branch of the same river, and Shignán-*cum*-Roshán, on the Ghund and Murgháb rivers. Wakhán is tributary to Badakshán, and south of it lies Kashkára, also called Chitrál. Northern Kashkára, including Yassan and Mastúj, is subordinate to the ruler of southern Kashkára, who resides at Chitrál. North of Gilgit we have the robber states of Hanza and Nagar or Kanjúd. South of Gilgit, in the valley of the Indus below Banji or Bawanji, are a number of small republics, who manage their affairs in assemblies called *sigás*, with which we may compare the similar institutions at the opposite extremity of the Himálaya. Some of these, such as Dárel and Hodar, owe a nominal subjection to Kashmír. Further south we come to the independent tribes of Buner and Swát. West of the Indus, in the Kunar valley, are the Bajaur and Dír states, and between them and the Hindu Kush range the country of Káfiristan.[2] It may well be supposed that this rugged tract, the meeting-place of the Turanian, Iranian, and Aryan races, presents many points of interest to the ethnographer as well as to the geographer; but here we can but very briefly refer to them, however important they may be.

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[1] See section F. of references attached to this chapter.

[2] Lately partially explored by Major Tanner, R.E.

Afgháns.

We have already noticed an Aryan race, the Dárds, occupying Gilgit and forming a part of the population of the neighbouring states. Here they meet the great Iranian race, which, under the name Tájik or Galcha, form the bulk of the cultivating population of the Musalmán states between the Indus and Jaxartes. History tells us that from the third century before Christ to the sixth century after Christ this tract was subject to the continued incursions of a Skythian race, traces of whom may be seen in the Brahúis of Biluchistán, the Hazárahs of the Hindu Kush, the Gujars there and in India, the Gakkars and Kohistánis of the Indus, and the Játs of India, and who have continued to influence the entire history of this tract to the present day. In the eleventh century the Afgháns were a small tribe in the Sulaimán mountains, of no importance and but little known. Since then they have increased so much as to have been able to annex a considerable extent of country, and to impose their language, Pukhtu or Pushtu, on the populations which they have absorbed. Along the Indus, Afgháns occupy the villages as far as Batera in 34° 53′ north latitude, where the Kohistán commences. The Afgháns themselves are tolerably fair, robust, and of moderate stature. They have long faces, high cheek-bones, and dark hair, which they wear unshaved. Their underclothing is of cotton, over which they throw a loose coat of woollen cloth, felt, or, more commonly, of sheepskin. They wear low caps on their heads, around which a cloth is twisted to form a turban. Boots are generally worn, and they carry a matchlock, scymitar, and shield. Leavened bread and meat are eaten by all classes. The women are rigorously secluded in the towns, but in the country, beyond the influence of the local maulvi or mullah, much more liberty is allowed. The use of wine is forbidden, but in the hills it is taken in secret, and that made in the Dárel valley has more than a local reputation. Pushtu approaches the Pehlavi or Zendic form of old Persian on the one hand, and the Sindhi form of Prákrit on the other. It is spoken throughout Afghánistán, and, with dialectal variations, in

Bajaur, Panjkora, Dír, and Swát. Afgháns are Sunni Muhammadans.

Kohistán, Kashkára.

The Kohistánis of the Indus claim an Arab descent and speak a language different from Pushtu and akin to Kashkári and Dárdui. They are fair and have sandy hair, and are of a robust make. They wear a tight-fitting coat and trousers resembling somewhat those of the European, with a cap of brown woollen material in the form of a bag rolled up at the edges. Around the legs and the feet a goatskin is wound, kept in its place by a strap of leather, the great-toe and the heel being left bare. A matchlock and sword are always carried, and they are expert shots. The women wear a loose jacket and trousers, and a cap of cotton or wool, over which they throw a woollen or cotton sheet when proceeding far from their villages. Unleavened bread of wheat, barley or millet *(Holcus sorghum)* is eaten with vegetables, milk, butter, or stewed meat. Further north the people are less prosperous and more regardless of cleanliness. In some of the villages there are colonies of pastoral Gújars, and in the Yassan villages settlements of Dúms, who supply the musicians and dancers of the country. Following next the Kunar valley, we have dialects of Pushtu spoken in Bajaur and Dír as far as the Lahori pass leading into Chitrál. Here it meets the Kashkára, which is akin to the Dárdui and is of Prákritic origin, though many Persian vocables have been added. The pagan inhabitants of Káfiristan are of the same race as the Kashkáras and the Dárds, and speak a language having an archaic Prákritic origin.

Galcha states.

Moving further westward into Badakshán, we come amongst a large Iranian population speaking Pushtu in the south and Persian in the north, and from Narín an Uzbeg population speaking Túrki, and the nomad Hazárahs having a dialect of their own. On the invasion of the Turks the old inhabitants retreated into the more inaccessible valleys of the great ranges, and there founded the Galcha states of Darwáz, Karátigin, Shighnán, and Wakhán. In Darwáz and the adjoining parts of Badakshán pure Persian is spoken or understood. The vocables and grammar of the Galcha proper show a strong affinity to Dárdui, and many conjecture that, in its pure state, it must have been the intermediate link between the Iranian and Indian branches of the great Aryan family; that the dispersion took place from the '*bám-i-dunya*,' 'the roof of the world,' the Indian branch proceeding southwards and along the Kábul river to India, whilst the Iranian branch crossed the Pámír to the plains of Turkistán. Towards the plains the Galchas are Sunnis, but in all the hill districts, except Darwáz, they are Shiáhs. The Shiáh is held in the same contempt as the infidel, and the Sunni esteems it a holy and righteous act to capture and sell his less orthodox fellow-believer into slavery. Amongst the tribute paid by the hill states to the Afghán governors of Badakshán and to the Wali of Bukhára, not the least important parts are the troops of fair-complexioned girls from the upper valleys of the Galcha states, and, when procurable, pagan boys from Káfiristán. Uzbegs are chiefly found in the country, and Tájiks in the towns along the plains below Badakshán and in Turkistán; the former invariably speak Túrki and the latter Persian, or dialects with a number of Persian words in them. In Wakhán the men wear brown woollen coats and trousers, Ladáki boots, and a scanty cotton turban, either blue or white. The women here also dress much like the men, and, as in Chitrál, wear their hair in long plaits. They have Jewish noses and are not very fair-looking. Kirghiz are found along the eastern slopes of the Tian-shán and the northern slopes of the Pámír and Kuen-lun ranges in Chinese Turkistán. The Alai Kirghiz of the Pámir have a bad reputation as robbers. East of them lie the great uninhabited steppes until we come to the country near Kanjúd, which is rendered unsafe by the raids of the people of Hunza and Nagar. Further east we have the Chang-thang highlands, occupied by the robber Bhotiya tribes of Changpás, speaking a Tibetan dialect akin to Zanskári. The dress of the male Kirghiz inhabiting the pastoral slopes of the highlands south of Yárkand and Káshgar is not different in any material degree from that of the other inhabitants.[1] Their women wear as a head-dress a white cloth rolled evenly and regularly round a skull-cap of red or other bright material, with lappets over the ears. The end of the turban is drawn down and passed over the lappets and under the chin, and the coat worn is a dressing-grown of wadded and quilted cotton. In the plains the winter dress of the females comprises a fur cap of black lamb's wool with a trimming of the fur, and a crown of coloured silk or cloth worn over a square of muslin which forms a veil. The coat worn is full and long, and the boots are of embroidered leather with high heels. The hair is worn either in two long plaits or in ringlets. The men wear a close-fitting cap lined with fur and turned up at the bottom. The coat resembles that worn by the women, only it is fastened by a cotton girdle, and the boots are worn long and plain, with felt stockings. In winter, sheepskin with the wool attached is the universal material for clothing.

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[1] Gordon: Roof of the World.

Kára-kurchins.

To Prejevalsky we are indebted for an account of the people around the lake country of the Tarim near Lob-nor, to the north of the Altyn-Tágh, and of those inhabiting the eastern extremity of the Kuen-lun near the sources of the Hoang-ho. The former[1] present "a strange mixture of facial types, some of which call to mind a Mongolian race. The prevailing characteristics are, however, Aryan, though far from pure. * * In height they are rather below the average; frame weak and hollow-chested; cheek-bones prominent and chin pointed; beard scanty and *à l'Espagnole;* whisker even smaller; hair on the face generally of feeble growth; lips often thick and protruding; teeth white and regular and skin dark, whence their name Kára-kurchin may be derived." Their language is said to resemble closely the dialect of Khoten. The clothing of the lake-dwellers is made from the fibres of a species of *asclepias,* and consists of a loose coat and trousers with, in winter, a sheep-skin cap, and in summer one made of felt. In summer the feet are uncovered, and in winter shoes of untanned hide are worn. The coats in winter are lined with duckskins dressed in salt. Fish, wild-fowl, and the tender shoots of reeds are their principal food. All profess the Muhammadan religion. The inhabitants of the country along the Tarim towards Korla appear to be also of the same race, though comparatively more civilised.

Tára-Tangutans.

To the north-east, towards the Yellow river, we have the Kára-Tangutans, a race apparently connected with the Tibetans proper. They are more robust in form, greater in stature, and darker in complexion, than the Tanguтans of Kan-su. Their hair is black, but the head is shaved clean and no pig-tails are worn. The eyes are dark and large, never narrow like the Mongols; the nose straight and sometimes aquiline and also sometimes *retroussée;* the lips thick and protruding; the cheek-bones not so prominent as in the Mongol; the face long and never flat, and the skin tawny coloured. The language is akin to Tibetan. The dress in summer comprises a long, grey, woollen coat reaching to the knees, boots, and a low-crowned, broad-brimmed, felt hat. In winter a sheepskin coat is put next the skin, and the upper part of the legs is usually left bare and also the right arm and part of the right breast, the right sleeve being allowed to hang down empty. The women dress like the men, and all live in tents made of black, coarse, woollen cloth, whence the name Kára (or black)-Tangutans. They are met as far as the Murui-ussu, the extreme point reached by Prejevalsky.[1] Of the people between the Hoang-ho and Brahmaputra very little is known beyond the fact that they are of Tibetan origin and chiefly Buddhists in religion. Pamutan near Bathang, which lies in about 99° east longitude and 28° 50′ north latitude, is the most westerly point attained by Mr. Cooper[2] in his memorable journey from Hankow towards the frontier of India in 1868; and Prun, in the Mishmi country, the most easterly point reached in his attempt to penetrate the intervening ranges to China in 1870, leaving a space of about 120 miles as the crow flies unexplored and unknown.

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[1] From Kulja across the Tian-shán to Lob-nor: London, 1879, pp. 44, 166. See, further, section G. of references attached to this chapter.

Tibet.

We have now briefly sketched the character of the countries and peoples encircling the great elevated area which from Ladák on the west to the Chinese frontier is known as Tibet, and is entirely under Chinese influence. The true name of this tract is Bod-yul or Bod-land, and the people Bod-pas, corrupted by the Indians into Bhotiyas, a name now applied to the Tibetans living on the borders between India and Tibet, whilst the people of Tibet proper are called Huniyas and the country Hundes. The eastern division of Tibet is known as Khám or Khám-yul, sometimes called Bod-chen; it extends from the frontiers of China to about 95° east longitude. Central Tibet or Tibet proper is called Bod at its eastern end, and

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[1] Mongolia, by Prejevalsky: London, 1876, II., pp. 109, 301.

[2] Travels of a Pioneer of Commerce in Pig-tail and Petticoats: London, 1871.

g-Nári or Nári at its north-western end; the former division being the shorter of the two, but perhaps broader and more civilised and populous. A line drawn from Darjíling northwards would apparently separate Bod from Nári. The central part is also called U-Tsang from the two provinces of U and Tsang in which Lhása is situated. Nári is divided into the three great districts of Mang-yul, Khorsum, and Mar-yul.[1] The first marches with Nepál almost to its western boundary; the second extends along the British frontier of Kumaun and Garhwál and that of the independent state of Bisahr; and the last included western Tibet and the Kashmíri states of Balti and Ladák. The physical characteristics of this tract have had the effect of isolating its inhabitants, who are distinct in race and language, from all the nations we have described, and find their affinities in the Tangutans of the north-eastern Kuen-lun already noticed. They are broadly built; have dark hair, scanty beards, high cheek-bones, oblique eyes, complexion fair amongst the better classes, dark amongst the lower, who are more exposed to the weather. To the east in the warmer valleys they are agriculturists, and to the west and north follow a pastoral life. The costume varies in the different provinces and with the means of the person, but as a rule the men in the wilder parts shave the head clean like the Kára-Tangutans, whilst the more settled allow it to grow long and plait it into a queue or tail like the Tangutans proper. To the east Chinese fashions are in vogue, and to the west the common dress is a coat and trousers of undyed woollen material with boots to the knee. The Lamas wear distinctive dresses, red or yellow according to the sect to which they belong, and the wealthier indulge in coloured broad-cloth garments of English or Russian manufacture. Barley porridge, tea and meat form the staple food of the people, and *chang* or beer, a simple infusion of malted barley, is of universal use all over Tibet.

General distribution.

Having completed our review of the nations inhabiting the Himálaya and the surrounding country, we may now briefly notice the natural distribution of the several great races that have come under our consideration in the special tracts that each now occupies. The extraordinary rigour of the climate and the physical barrier that exists between Tibet and India sufficiently explains the absence of ethnical or political relations between the two countries. Accident has given the Indian state of Kashmir political preponderance in western Tibet, but the ethnical distinction still remains, and will probably ever continue. The climatic condition of eastern and northern Tibet allows of a free migration of the inhabitants from one part to the other, which is shewn in the common origin of the people of those countries to the present day. Turks and Tartars occupy the country called Turkistán, similar in character to their original homes; but in proportion as the climatal conditions become Indian, so does the population become Aryan. The Tartar is the child of the rugged bleak steppes; and when we approach the cold and wooded mountains we come on the Hindu element at its maximum in the tract around the sacred sources of the Jumna and the Ganges, gradually diminishing as we move eastward towards the excessively moist though warmer valleys of the Nepál and Asám Himálaya, where they are replaced by races akin to the people of eastern Tibet and Siam, and on the west meeting the Iranian and the Tartar in the trans-Indus ranges. To the north of the Kuen-lun the Mongol and Chinese converts to Muhammadanism, called Tunganis, and in western Tibet the Muhammadan Baltis, divide the Buddhists from the followers of Islám. In the valleys of the affluents of the Oxus and the Kábul river we have an Iranian race of Galchas or Tájiks driven upwards by political disturbances and mixing with an indigenous mountain race of Aryan extraction. The rigorous climate and scanty cultivation which prevents the intrusion in any numbers of a southern race also debars the tribes inhabiting the higher hills from making any permanent occupation of the lowlands. Like their favourite domestic animal the yak, the Himálayan mountaineers do not thrive at low altitudes, nor can plains-bred men or animals withstand for any time the arctic cold and rarefied air of the more elevated regions. Thus, there is a clear connection between the distribution of the nations that are found in the Himálaya and the physical characteristics of the regions that they occupy; and if we had time to pursue the subject further, it might be shown that the orographical conditions of a tract have materially influenced its history, political and religious, and the social and moral character of its inhabitants. The disposition of a people towards peace or war; their migrations; the diffusion of their language; their habits, pastoral, agricultural, or commercial; the extent of their influence—all depend more or less on the physical peculiarities of the country that they inhabit. And not only is man so affected, but the entire fauna and flora obey the same laws, so that the skilful naturalist can from a plant or even a butterfly describe the general character of the country of which it is a native, and with it the customs and manners of the inhabitants. For the nature of a country, whether mountainous or level, the direction of the great ranges, the length and line of coast, the position with regard to the equator, the relations of land and water, and the drainage systems, are all primary agents in the distribution of organic life and of the influences which govern all atmospheric and climatic phenomena.

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[1] From Captain Henry Strachey's paper on the physical geography of Western Tibet, London, 1854, still our best authority on the subject. A more detailed account will be given hereafter in the Gazetteer portion of this memoir: see also section H. of references attached to this chapter.

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CHAPTER II.

PHYSICAL GEOGRAPHY OF THE HIMÁLAYA.

CONTENTS.

The Himálayan river basins—The Indus basin—Subordinate systems of the Indus basin ; The Ganges basin—Subordinate systems of the Ganges basin ; The Brahmaputra basin—Subordinate systems of the Brahmaputra basin ; Systems of Tibet—Lob-Nor basin , Oxus basin. Plains of Hindustán—Indus plain ; Indian desert ; Gangetic plain ; Asám valley ; Bhábar ; Tarái ; Siwáliks ; Dúns Extent of Bhábar—Cause of the deposit—Hodgson's oceanic theory ; Fluviatile theory ; Tarái ; Siwáliks ; Dúns ; Ganges to Brahmaputra ; Lower Himalaya. Materials *of the mountains*—Eocene period ; *Mode of mountain formation* ; Mountain-sculpture ; Ice-wedges ; Avalanches , Glaciers ; Rain ; Rivers.

The Himálaya.

We have already decided to restrict our use of the word 'Himálaya' to that portion of the great mountain girdle which lies between the bend of the Indus on the west and the unexplored gorge of the Brahmaputra on the east. Hodgson, in 1849, estimated the length of this range at 1,800 miles with a mean breadth of about 90 miles, a maximum breadth of 110 miles, and a minimum breadth of about 70 miles. In fixing the breadth of the Himálaya, however, as in determining its length, we have similar difficulties to contend with. For, as we have seen that the popular estimate as to the boundaries of the range may possibly be correctly extended both on the east and on the west, so on the north, the channels of the Indus and the Brahmaputra, which are commonly assigned as the northern limit, are found in a plateau, but little lower than the passes by which the traveller crosses the first line of snowy mountains into Tibet. On the south, we have a well-marked descent to the plains of India, but on the north there is no immediate descent to a lower country beyond. On the contrary, range after range is met with to the north, many of which may compete in altitude with the snowy mountains seen from the plains of northern India.

River-basins.

Before proceeding to a closer examination of the form of that portion of the Himálaya lying within the province of Kumaon, it will be convenient briefly to describe the river-basins throughout the Himálaya and endeavour to trace the general law underlying their arrangement. For as this depends in the main on the direction of the great ranges and the position of the great peaks, a consideration of it will conduce to a clearer apprehension of the entire mountain system itself as well as of the relations of its various parts. We find that from a water-parting about longitude 81° east and almost immediately due north of Kumaon, the drainage of the southern part of the Tibetan plateau flows north-west in the Indus and south-east in the Brahmaputra. These two rivers maintain a course along the length of the table-land, and receive as they proceed the drainage of a large part of its breadth; the exceptions being, first, the eastern border, which apparently is drained by the Lu-tse, the Lan-tsang, and the Murui-ussu, one of the sources of the Yang-tse-kiang;[1] second, an occasional strip along the southern edge from which the water passes off[2] more or less directly to the south through the Himálaya; and third, the north-western part from which the water has no escape, but is collected in lakes at the lowest level it can reach.[3] The waters thus accumulated in the two great streams are at length discharged by two openings in the Himálayan slope through the plains of India into the Indian Ocean. No great portion of the drainage of the table-land, so far as we know, passes in the opposite direction through the northern slope, and the area that discharges itself southward at points intermediate between the debouches of the Indus and the Brahmaputra is with one exception, that of the Satluj, comparatively small. The waters of the northern slope with a small area of the table-land adjoining flow down to the plains of eastern Turkistán: while, in like manner, those of the southern slope with the drainage of the exceptional area along the southern border of the table-land which passes through the line of water-parting from the north, give rise to such rivers as the Jhilam, Chináb, Ravi, Jumna,

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[1] From Prejevalsky's Mongolia (London, 1876) it would appear that his Burkhan Buddha range marks, in 96° longitude, the north-eastern termination of the Tibetan plateau. This range forms the southern boundary of the Tsaidam plain, which, according to native report, extends thence to Lob-Nor. The Nomokhun-gol, which rises on the southern face of the Burkhan Buddha range and joins the Baian-gol, does not appear to be a feeder of the Hoang-ho or Yellow River, which has its origin outside the Tibetan plateau. To the south of the Burkhan Buddha range the elevation is from 13,000 to 15,000 as far as the Murui-ussu, the bed of which, where seen by Prejevalsky, was 13,000 feet above the level of sea with a channel 750 feet broad in January. The name 'Murui-ussu' signifies 'the tortuous river,' and, according to Yule, it is the Bri-chu of the Tibetans, the Brius of Marco Polo, and the Yang-tse-kiang or Blue River of the Chinese. [2] By the Satlaj, Karnáli, and Arun. [3] Examples of river-systems without an outlet to the ocean are to be found in the basins of the Caspian, Aral, Balkhash, Lob-Nor, &c.

Ganges, Káli, Gandak, Kosi, and Tista. We thus see that the northern crest of the table-land or the summit of its northern slope practically forms the water-parting between the rivers that flow southwards and those that lose themselves in the plain of Gobi In the southern crest we have a subordinate water-parting separating the rivers that fall into the Indian Ocean into two classes; first, those that rise on that slope and flow directly down it to the plains of Hindustán; and secondly, those that are collected along the table-land and are finally discharged also through the southern slope, chiefly by two concentrated channels at distant points towards the ends of the range. Captain Henry Strachey[1] has called the northern crest of the table-land the Turkish, and the southern the Indian water-parting.

Indus basin.

If we examine the river-systems having their source in the Himálaya, we find a regularity of plan and arrangement which at first sight would not be expected. Taking the Indus basin and its system, we see that the Satlaj and all the rivers that join the Indus on its left bank have a south-westerly direction towards the Arabian Sea. On the east this system is bounded by the small inland basin of the Kaggar, which receives the drainage from an inconsiderable portion of the outer hills between the Satlaj and the Jumna, and finally loses its waters in the Indian desert. The eastern water-parting of the Indus system is found in the elevated range extending from the main Himálayan mass along the left bank of the Satlaj to Rúpur, and is continued thence in the uplands bordering the *khádir* of that river until it meets the Arvali (Aravali) range which constitutes the north-western abutment of the table-land of Central India. The character of the slope towards the south-west will be best understood from the following table of heights taken along the course of the Satlaj to Ludhiána, and thence by the Grand Trunk Road to the Jumna :—Táru, about two miles below the junction of the Panjnad and Indus, 337 feet above the level of the sea ; Baháwalpur, 375 feet ; Núr Sháh, 481 feet ; Pír Khális, seven miles north-east of Baháwalgarh, 548 feet ; Fazilka, 588 feet ; Firozpur cantonment, 645 feet ; Jagraon, 765 feet ; Ludhiána, 806 feet ; Amballa Church, 899 feet ; and Madalpur, on the banks of the Jumna khádir, 906 feet. From Sodiwála in the Firozpur district southwards on the 75th meridian we have Sodiwála, 718 feet; Ahmadwála, 705 feet; Sirsa, on a mound, 737 feet; level of Sambhar lake, 1,184 feet.[1] These observations show a slight depression towards the south in addition to that towards the south-west, and would make us include the Kaggar inland basin in the Indus system. The Sotra or Hakra, the ancient river of the Indian desert, seems, however, to have once had its debouche in the Ran of Kachh,[2] and would therefore be still entitled to be considered separate. To the west the Rávi and the Chínáb run in lines almost parallel to the Satlaj, as well as the Jhilam, from the town of that name, until it takes a bend to the south to its junction with the Chínáb. To the west, the water-parting of the Indus commences at Cape Monze on the Arabian Sea, and advances nearly northwards along the Hala mountains to the east of Sohráb, Kalát, and Quettah (Kwatah). It thence continues in the same direction along the western Sulaimán range, also known as the Konak, and Káh Jadrán range to the Safed-koh, at the head of the Kurram valley. Thence it follows the crest of the Safedkoh westwards to the hills north of Ghazni, where it separates the southern affluents of the Kábul river from the waters of the small inland basin of lake Abistáda. The direction is then continued north-westerly to the ridge separating the head-waters of the Argand-áb from those of the Kábul river, and again in the range that separates the waters of the Halmand basin from the most westerly affluents of the Kábul river, whence a transverse ridge near the pass to Bámian connects the line of water-parting with the Hindu-kush. For 300 miles the line follows the Hindu-kush to its junction with the great Tághdumbásh Pámír near the Baroghil pass. It then follows the Muztágh range,[3] but cuts through it around by the Kárakoram pass to the north, so as to include the tributaries of the Shayok, and proceeds in a south-easterly direction by the Aling Gang-ri to its junction with the Gang-ri at Kailás, where a transverse ridge separates the head-waters of the Indus, the Brahmaputra, and the trans-Himálayan feeder of the Ganges system. The Indus has a length of 1,800 miles, and, according to Mr. Saunders, its basin has an area of 372,000 square miles.

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[1] J. R. G. S., XXIII., p. 7.

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[1] G. T. S. tables.

[2] See Notes on the lost river of the Indian desert, Cal. Rev., July, 1874.

[3] 'Ice-mountain': a better name than Kárakoram (black-gravel), which should be restricted to the pass.

Subordinate systems of the Indus basin

The Hala mountains to the south of the Mula pass are better known as the Khirthar hills and as the Pubh hills, and the drainage from them loses itself in the plains before it can reach the Indus. The same may be said of the drainage through the Mula and Bolan passes, and that by the Thal valley. To the north, the Luni, Gomal, Kurram, and Kábul rivers, each possessing a perennial stream, have an easterly course more or less parallel to each other, and break through the range bordering the right bank of the Indus by deep and narrow gorges which form the passes into the upper country. The Kábul river itself is the drainage channel for the very elevated country from the hills north of Ghazni to the Baroghil pass north of Chitrál, and from Naushera to the pass leading to Bámián, and thus forms a compact subordinate system well deserving of separate study.[1] The upper waters of the Jhilam drain the Tilc and Kashmir valleys, and have a general direction between west and north to Muzaffarabad, where they unite, and, meeting a meridional ridge, take a bend southwards to the plains. The Chínáb, in the upper portion of its course known as the Chandra, has a similar direction between west and north until it meets the spurs from the range which forms the water-parting between it and the Jhilam, whence it seeks an outlet southwards towards the plains. The Ravi runs in a valley parallel to that of the Chínáb and south of it until it meets the outliers of the range that forms the water-parting between it and the Chínáb, when it also turns suddenly southwards towards the plains. Next comes the Biás, which has also a westerly direction until it meets the ridge between it and the Ravi, when it takes a bend to the south through the outer hills. The upper course of the Satlaj has a similar westerly trend until it meets the great obstruction culminating in the Leo Porgyul peak, after which the direction is between west and south until it enters the plains. A range runs between the Satlaj and the southern branch of the Indus from the meridian of Tirthapuri by Gár, to where it is joined by the ridge connecting it with Leo Porgyul, and thence into Rupshu to the north of the Tso Moriri lake, and constitutes the subordinate water-parting between the Satlaj itself and the

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[1] For interesting articles on the tract between the Arabian sea and the Gilgit river, by Mr. C R Markham, see *Proceedings R G. S.*, 1879 the mountain passes on the Afghán frontier of British India, p 38 the upper basin of the Kábul river p 110 the basin of the Helmund, p. 191.

Indus. Thus we see that the great feeders of the Indus system from the west have a similar character, and that those from the east, from the Himálaya proper, have a general westerly direction, in the upper portions of their courses in the hills, until they turn southwards towards the plains, where the direction is south-west to their junction with the Indus.

The Ganges basin.

Next we have the Ganges basin with its subordinate systems. To the north, the water-parting, as a rule, follows the ghát-line of the Himálaya and on the extreme west separates the sources of the Jádh-Ganga, one of the head-waters of the Bhágirathi, from the Hop-gadh, an affluent of the Satlaj. North of Kumaon, however, we have a phenomenon similar to that observed near the Kárakoram[1] pass, where the waters of the Shayok, Yárkand, and Kárakash rivers have a common origin in that elevated plateau at no great distance from each other. We find that to the east of the Unta-dhúra pass, north of Milam in Kumaon, the water-parting of the Ganges basin crosses to the north of the ghát-line to a place called Tara, where the sources of the Satlaj and the Karnáli lie close together, "divided by an almost level plain, across which a man might walk from one river to the other in an hour or two, without a vertical ascent or descent of 500 feet," yet the waters of one stream seek the sea at Karáchi, and of the other by Goalundo. Further east the water-parting is continued in the ghát-line to the Arun river, which has its sources to the north and forces for itself a way through the Himálaya to the plains. The water-parting then follows the eastern boundary of Nepál to the plains, where an intricate system of drainage is met with, throwing off feeders sometimes to the Brahmaputra and sometimes to the Ganges down to their junction at Goalundo. Following the line on the west from east longitude 79° 11′ and north latitude 25°, we find in the extreme north-west that the water-parting keeps to the crest of the range running along the left bank of the Baspa, an affluent of the Satlaj, and is continued by Hattu to the ridge on which Simla is built. Thence it proceeds southward, and then eastward along the right bank of the Giri to the junction of that stream with the Jumna near Rájghát. Here the water-parting turns southwards along the line separating the drainage area of the Kaggar system from that of the Jumna, and continuing along the Arvali range and the edge of the Málwa plateau, passes through the Jabalpur and Mandla districts, separating the sources of the Nerbudda from those of the Son, and then along the range connecting the Sátpuras with the Rájmahál hills to the plains, where it follows a course along the left bank of the Sabanreka to the sea. Mr. Saunders has given the length of the main stream of the Ganges as 1,514 miles, and the area of its basin at 391,000 square miles.

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[1] Dr. Scully describes the appearance of the country between the top of one of the Shayok gorges and the Kárakoram pass thus :—"At the top of the ascent a strange sight met our eyes, for we found ourselves on an immense undulating plain, the Dipsang, which looked like the top of the world * * Northwards, in front of us, we saw a few irregular flat-topped hillocks, they looked like scattered about * * I had occasion to look back in the direction of the route by which we had come. A fine snowy range of mountains met my view and looked quite continuous, but, of course, this was a deceptive appearance, as we had passed through this chain without crossing any pass." This was the Muztágh range, whilst the Kárakoram pass, distant about 25 miles ahead and forming the water-parting, lay amongst the seeming hillocks, a fact which shows that though a range may form a water-parting, a water-parting does not always form a part of a range Colonel Gordon gives views of the Kárakoram pass in his 'Roof of the World.'"

Subordinate systems of the Ganges basin.

The Ganges basin, like that of the Indus, possesses several subordinate systems that may be called in their order from west to east, the Jumna-Ganges, Karnáli, Gandak, and Kosi systems. The alpine basin of the Jumna-Ganges system is bounded on the west by the well-defined range which descends from the Jamnotri group of peaks to the Satlaj river, and on the east by a similar ridge descending from the Nanda Devi group of peaks and separating the waters of the Pindar from those of the Himálayan Sarju. To the north, the ghát-line separates it from the source of the Karnáli on the east, and the source of the Satlaj on the west. Although the upper waters of both the Jumna and the Alaknanda, or principal source of the Ganges, have at first a westerly direction, they soon take a bend to the south, and form the main channels to which are directed their affluents from either side. It is remarkable that, with the exception of the Rámganga, which unites with the Ganges in the Farukhabad district, neither the Jumna nor the Ganges before their junction receives any considerable affluent of Himálayan origin during its course through the plains. The western boundary of the alpine basin of the Karnáli is marked by the ridge extending from the Nanda Devi group between the Pindar and Sarju rivers, already noticed. The eastern boundary is formed by a similar ridge descending from the Dhaulagiri group of peaks. To the west the Sarju, eastern Rámganga, Gori, and Káli enter the plains in one stream as the Sárda. Then the Swetaganga Karnáli, and Bheri form the Karnáli, and further east we have the Jhingrak or Rápti and its affluents All unite in the plains to form the Ghogra, which joins the Ganges to the south of the Gházipur district. But this unitising law is better exemplified in the alpine basin of the Gandak, which reaches from the Dhaulagiri group to the Gosáin-thán group of peaks. We have here seven rivers named in order from west to east, the Barigár, Naráyani, Swetigandaki, Marsyángdi, Daramdi, Burhiya-Gandaki, and Trisúl-Gandaki. These are called the seven Gandaki by the Nepálese, and unite their waters at Tribeni within the hills to form the Gandak river of the plains. Here we have what Hodgson[1] terms an admirably defined natural division lying between two great groups of peaks. In the same manner as the Karnáli basin is bounded on the west by the spur descending from the Nanda-Devi group of peaks, and on the east by the ridge from the Dhaulagiri group, so the Barigár of the Gandak system does not receive a single streamlet from the westward of the Dhaulagiri ridge, nor does the Trisúl of the same system receive any water from the east of the ridge descending from Gosáin-thán. The alpine basin of the Kosi lies between the Gosáin-thán group and the Kanchinjinga group of peaks, and, like the Gandak system, consists of seven rivers,[2] known as the seven Kosis. These, named in their order from west to east, are the Milamchi or Indrawati, the Bhotiya-Kosi, Támba-Kosi, Likhu-Kosi, Dúd-Kosi, Arun, and Tamra or Tamor. The Arun has one of its sources to the north of the line of snowy peaks seen from the plains, and the Tamor is also said to have trans-nivean affluents, but all the others rise on the southern slope of the Himálaya, and unite within the hills at Varáha-Kshetra above Náthpur. The subordinate systems of the Ganges basin thus appear to be strongly characterised by a common origin within an area bounded on the north by the ghát-line, and on the west and east by well-marked groups of culminating peaks, whence ridges descend and form the water-parting between successive systems.

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[1] See his article on the Ganges basin, J. A. S. Ben., XVIII., 761. [2] *Ibid.*, XVII., ii., 646.

Brahmaputra basin

The Brahmaputra basin in its full extent has not been explored, but sufficient evidence has been collected by recent travellers to show that from the water-parting between the sources of the Brahmaputra and the Indus, the northern water-parting of the former river continues in a range of lofty peaks on its left bank to the bend towards the south, by which it reaches the plains of India. This range has a direction south-east, and to the west of the 86th meridian is sufficiently distant from the Brahmaputra to allow of such affluents as the Chachu and the Charta rivers. About the 86th meridian, a line of peaks culminating in the Tárgot La stretch in a north-easterly direction to the Gyákhárma group of peaks, south-east of the Kyáring-cho or Kyáring lake, one of the sources of the Nák-chu-kha. The drainage of the southern slope of the range is sent by the Dumphu-chu into the Kyáring lake, so that the northern water-parting of the Brahmaputra must here approach much closer to the river and run in a south-easterly direction. On the 89th meridian, it descends as low as the 30th parallel in the Shiang Lahu range, which appears to be connected with the great Ninjin-thángla range of snowy peaks to the south of the Jáng Namcho or Tengri-Nor lake with a trend to the north-east, for it gives the head-waters of the Ki-chu or Lhása river from its southern slope, as well as other important streams further east, regarding which our information is still very imperfect. To the north-east we find the Nák-chu-kha or Hota Sanpo, a large river that issues from the Chargut lake about north latitude 32° and east longitude 89°, and flows eastward, having its drainage area on the south, bounded by the water-parting between it and the Brahmaputra basin. This great river takes a bend to the south, and according to one of the Pandit explorers,[1] flows by Tsiamdo on the road from Lhása to Bathang, and thence through Amdu to China, under the names Máchu and Konkong. These names would connect it with the Yang-tse, but if it flows by Tsiamdo it should be one of the branches of the Lan-Tsang, the name of the upper portion of the Mekong or Kambodia river. Des Godins notes that the Nu-Tse or Lu-Tse is known as the Ngen-kio in Tibet, a name which may perhaps be referred to the Nák-chu, and it would then be the head-waters of the Salween, whilst others claim it as the source of the Irawadi. All that can, therefore, be said is that there is a great river in eastern Tibet, between which and the Brahmaputra is an unexplored tract of country, and within it will be found the eastern water-parting of the Brahmaputra. So far as we may conjecture from the imperfect materials at our command, the range that forms the northern water-parting of the Brahmaputra takes a sudden bend southwards between the 96th and 97th meridians along the right bank of the Lu-Tse. Thence one branch proceeds westwards in the Patkoi range, and another southwards, between the Irawadi and Salween. *To the south, the water-parting follows the crest of the Patkoi* range, and is continued westwards in the Manipur, Lushái, and Chittagong hills, where it separates the southern affluents of the Brahmaputra from those of the Barmese systems. To the west, the water-parting is conterminous with that of the Ganges basin. Mr. Saunders estimates the course of the Brahmaputra at 1,800 miles, and the area of its basin at 361,000 square miles.

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[1] G. T. S. Rep., 1873-75, p. 63. The *Athenæum* of the 17th April, 1880, announces the arrival of Colonel Prejevalsky at Nák-chu-kha, about twelve marches north of Lhasa, and we shall doubtless obtain some solution of the problem connected with this river from this great traveller.

Subordinate systems of the Brahmaputra basin.

Following the systems that carry off the drainage from the southern slopes of the Himálaya and join the Brahmaputra in its course through the plains, we trace much the same regularity found in the subordinate systems of the Ganges basin further west. The Tísta system of Sikkim is bounded on the west by a ridge descending from the Kanchinjinga group of peaks, and on the east by a similar ridge from the Chumaléri group that also forms the eastern boundary of Sikkim. The alpine rivers of this system in order from west to east are the Bári Ranjít, Ratong, Lachen, Lachung, and Rang-chu, and all unite within the hills above Kalingpong to the east of Darjiling. The alpine basin of the Tarsa-Gangadhar system extends from the Chumalári group on the west to the ridge descending some fifteen miles east of the 90th meridian in the 28th parallel, and which separates the waters of the affluents of the Tarsa from those of the Manás system. The rivers of this alpine basin from west to east are the Ammo, Dor, Par, Wang, Ma, Pachu, and Tanchu, which unite within the hills to form the Tarsa and the Gangadhar tributaries of the Brahmaputra. Further east comes the Manás system, of which the western water-parting is conterminous with that of the Tarsa-Gangadhar system. On the east, it is bounded by a ridge descending from the group of snowy peaks to the west of the Karkang pass crossed by the Pandit on the Táwáng route in 1873, and for its alpine feeders has the Mati, Manás, Kuru, Lhopra, and Táwáng streams, which apparently also unite within the verge of the mountains to form the Manás. Eastwards lies the Subansiri system between the Manás and the Dihong. The Sikang-chu, which rises to the south of the Karkang pass, probably forms one of its sources, but the remainder lie within the wild country of the Abors and have not yet been explored. The southern affluents of the Brahmaputra during its course through the valley of Asám are not so important, and may be divided into two classes—those which carry the drainage of the northern slope of the hills inhabited by the Singpho, Aror, and Nága tribes, and fall directly into the Brahmaputra, and those which carry the drainage of the northern slope of the hills of the Lushái country and hill Tipura and of the southern slopes of the Jaintiya, Khasiya, and Gáro hills to the Megna, which joins the Brahmaputra below Dakka. To the former class belong the Dihing, Disung, Southern Dhansiri, and Kopili, and to the latter the Barak, Súrma, and Dhani.[1] To the extreme east of the Asám valley is a snowy range from which issues the Lohit or Brahmakund river that gives its name to the Brahmaputra; but geographers have applied the same name to the great river flowing by Lhása, and which the best authorities identify with the Dihong that joins the Lohit in the upper valley of Asám. The more general name of the Brahmaputra, in the upper portion of its course, seems to be 'Tsanpo' or 'Sanpo,' meaning 'the river' or 'the great river,' used like 'Ganga' in the plains and 'Kiang' in China. In Asám, the name varies with the tribe inhabiting its banks or those of its tributaries, so that the designation 'Brahmaputra,' to express the entire course of the river from its source to the north of Kumaon to its junction with the Ganges, must be considered a convenient device of geographers, and not a term based on received usage. We have seen that at its junction with the Lohit, the Brahmaputra is called the Dihong.[1] East of this junction, the Lohit receives a tributary from the north, called the Dihong, and on the south another called the Dihing, and again one called the Disang. Much confusion has resulted in Asám geography from not remembering that all these names refer to different rivers.[2]

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[1] Any further discussion of the systems of the Asám valley would be out of place here; they are sufficiently described in the Asám Gazetteer, to which the reader in search of further information on this subject is referred

Tibet.

We have already noticed the division of Tibet into the eastern, western, and central provinces. It is called Si-tsang by the Chinese, and is also known under the names Tu-pu and Mu-tu, or Upper and Lower Tibet. From the accounts of the eastern province in the writings of Klaproth, Huc, Blakeston, Cooper, Des Godins, and Gill, we may assume that the drainage to the east of the 96th meridian has a southerly direction, and that the general conditions resemble much those further west. Pengshan on the Yang-tse in western Sz-chuen is 1,500 feet above the level of the sea. At Chung-tu, some seventy miles due north of Peng-han, Cooper, in March, found the fields in the neighbourhood occupied by luxuriant crops of wheat, barley, sugarcane, and opium, the latter of which demands a climate similar to that of the plains below the Kumaon Himálaya. The same traveller crossed the Yalung and Kin-ha branches of the Yang-tse between Chingtu and Bathang, and beyond Tatsien-lu entered Eastern Tibet, where yaks are used in the carrying trade and a more alpine climate is met with. Bathang on the west has much the same position with respect to the elevated highland to the north that Chingtu has on the east, but lies a degree of latitude more to the south than Chingtu; so that from the meridian of Bathang, the range dividing the Tibetan plateau from the plains of China seems to take a north-easterly direction. The feeders of the Yang-tse and other rivers find their way through this range by a series of gorges similar to that of the Dihong further west. Between the Yang-tse and the Dihong, we have two great rivers, the Lan-tsang identified with the Mekong or river of Kambodia, and the Lu-tse or upper course of the Salween. Father Des Godins informs us that the Mekong has its origin in about 33° to 34° north latitude in the mountains south of Koko-Nor, and the Lu-tse further west is known as the Ngen-kio in Tibet; but whether this name is to be regarded as one with the Nák-chu-kha of the Pandit explorer is left to future travellers to decide.

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[1] Klaproth suggested the Irawadi as the continuation of the Sanpo, and Colonel Godwin-Austen was the principal advocate for the Subansiri, Progs. R. G. S., August, 1876; but the researches of the Pandit employed by Lieutenant Harman perhaps show that the Dihong is the real representative of the Sanpo, and that the bend it takes beyond Chetang is quite sufficient to leave a large water-shed for the Subansiri. The most recent advocate of the Irawadi as the true continuation of the Sanpo is Mr. R. Gordon, in his elaborate "*Report on the Irrawaddy River.*" The first volume is illustrated with hydrographical hypsometrical and orographical maps of Tibet and the neighbouring countries together with a hyetographical map of India.

[2] See Peal's observations on Asám nomenclature in J.A.S., Ben.

Turning now to the upper portions of central and western Tibet, we find from the Pandit explorations that the drainage to the north of the northern water-parting of the upper portions of both the Indus and the Brahmaputra flows into a number of lakes. East of the 84th meridian, these lakes appear to be connected the one with the other, and eventually with the great river Nák-chu-kha, which has an easterly direction in the upper part of its course and finds a southern outlet in one of the great rivers to the east of the Dihong. From the Pangong lake on the west to the Lonkor Cho between the 83rd and 84th meridians on the east, the drainage is collected in a series of depressions without any outlet, each of which is the centre of a subordinate minor system of its own. We do not know of any considerable stream proceeding northwards or westwards from this tract. This lake-system is a characteristic feature of the orography of north-western Tibet. The waters of these lakes are generally brackish and the margins exhibit expanses of salt-marsh. Streams of fresh water are found, but in their course towards the lakes these rapidly become brackish, and in the end little influence the quality of the lake-water itself. According to the Pandit, the country to the north of Garge and Garchethol is a great uninhabited plain.[1] It was formerly customary to travel in a north-north-westerly direction from Thok Daurákpa[2] for some twenty days to the range overlooking the Gobi plain in which the commercial entrepôt Nári Tháru lay.[3] A two months' journey from Thok Daurákpa to the north-east brought the traveller to Ajan, also a commercial centre.[1] This road lay throughout over an extensive plain; no large mountains were seen and no streams were crossed. Drinking-water was obtained from a number of fresh-water lakes mostly dependent on the rainfall for their supply. From these reports we learn that northern Tibet is a plateau of great elevation without inhabitants and possessed of few streams.

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[1] Called Jung Pháyil Payil, meaning literally "the desert country in which the father and son have wandered," from a tradition that two men had entered it and died there from want of water. G. T. S. Rep., 1873-75, p. 55. [2] In about 85° 8′ east longitude, and 32° 7′ north latitude. [3] Trotter suggests that Nári Tháru occupies a position at the foot of the northern boundary ridge of the Tibetan plateau, similar to that held by Polu and Sorghák, and that the stream passing Nári Tháru may be the same that passes by Charchand. Prejevalsky (p. 76) says that Charchen is situate about 200 miles to the south-west of Chargalik on a river of the same name. Hence it is a ten days' journey to the oasis of Nai (900 houses), and three days further to Kiria. The position and distance of Nai would suit the Pandit's description of Nári Tháru.

Lob-Nor basin.

As we approach the west, the boundary ranges that support the Tibetan plateau between them on the north and south gradually incline towards each other, so that westwards of the Pangong lake they are little more than fifty miles apart.[2] Here we find the water-parting of the Indus and Lob-Nor systems in the elevated Dipsang plain, which attains a height of 18,000 feet above the level of the sea near the Kárakoram pass (18,550 feet). From the Kárakoram pass on the north flows a feeder of the Yárkand river, and from the east, an affluent of the Kárakash river, both of which belong to the Lob-Nor system. On the south-east, only eleven miles from the pass, the Daulat-beguldi encamping ground is close to one of the feeders of the Nubra branch of the Shayok river that belongs to the Indus system. In one case the waters lose themselves in the Gobi desert, and in the other they reach the Indian Ocean at Karáchi. If the statements of Kostenko and Severtsof be accepted, we have here in the west an analogue of the arrangement that has been described as characteristic of all the river-systems along the southern face of the Himálaya between the Jumna and the Brahmaputra. The alpine basin of the Yamanyár lies between two great groups of peaks, some thirty miles apart. On the south-east of the Yamanyár is the Tágharma group, of which the Muztágh-Ata[3] peak attains an elevation of 25,350 feet above the level of the sea. On the north-west there is a similar group, of which the Tásh-balik peak reaches an elevation of 22,500 feet. The Yamanyár collects its waters in an elevated valley between these groups and the water-parting range on the west, which is known variously as the Tágharma plain or plain of the Kichik Kára-kul.[1] The groups themselves are in advance of the water-parting range and are connected with it by transverse ridges. That on the south connects the Muztágh-Ata group near the Kok Mainak pass with the water-parting range, west of the Neza-tásh pass, while that on the north has not yet been accurately defined. Spurs from the groups descend northwards towards the plains and effectually divide the waters of the Yamanyár from those of the Kashgár-darya on the west and from those of the Yárkand river on the east. It has generally been supposed[2] that these two groups of peaks belonged to a great meridional range; but Severtsof, who has had recently exceptional means for obtaining an accurate estimate of its character, distinctly states that "these two peaks were supposed to be connected by a continuous range, while the real fact is that each is respectively the highest point of separate small high mountain knots capped with eternal snow." We have, therefore, in the west also an apparent snowy chain of mountains as seen from the plains, but which on closer examination resolves itself into groups of snowy peaks in advance of the water-parting range from which they are divided by an elevated valley. This valley gives rise to a river that makes a way for itself between the boundary groups to the plains below, while the groups themselves are connected by transverse ridges with the line of water-parting. A ridge from Muztágh-Ata to Yangi Hissar separates the drainage of the northern slope from that of the Kínkol river on the east, and a second ridge follows at some distance the left bank of the Yamanyár which shortly after its issue from the mountains is absorbed in artificial branches or canals for irrigation purposes. The whole system is a remarkable illustration of Hodgson's formula for the river-systems of the eastern Himálaya.

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[1] On approaching Ajan, a bare rocky range is passed and the town is occupied by Sokpos, who procure their corn and flour from Kokod and Karka, a large monastery some ten or twelve days' journey beyond the borders of their country. Trotter suggests that Karka lies between Lob-Nor and Koko-Nor, and that Ajan is one with the Anj-si of Uspenski, but both of these identifications require confirmation.

[2] From the Karakoram to Shahídullah (11,780 feet) on the verge of the plains of Yárkand is a distance by road of 78 miles and from the same to Changlung on the south is 83 miles, and to Leh on the Indus, 163 miles.

[3] 'Father of ice-mountains.'

Oxus basin.

The alpine affluents of the Yárkand river known as the Sarikol and Zarafshán rivers also illustrate the unitising principle observed elsewhere. They are separated from each other by the Kandár range, which descends in a north-easterly direction from the water-parting range to the south, and terminates where the Sarikol and Zarafshán unite their waters within the outer range of hills to the north. The Oxus system further gives an example of another of the characteristic features of the Himálayan river-systems. The water-parting follows the line of the Hindu Kush from the pass near Bámian to the Baroghil pass, and thence follows the Pámir range to the greater Kára-kul. The height of the water-parting on the Baroghil plain has been estimated by Captain Biddulph at about 12,000 feet. The Mullah states that in traversing it for a distance of five miles there was no appreciable rise or fall, and further it is said that from a point one-and-a-half miles short of the crest, the difference in height did not appear to be more than two hundred feet. The Sarhad head of the Panjah branch of the Oxus is not more than two miles distant from the Gez-kul or Oi-kul, the longest source of the Aksu branch of the same river known as the Murgháb. The principal source of the western head of the Panjah branch of the Oxus in Wood's Victoria lake is but twelve miles distant from the water-parting between it and another branch of the Aksu. So little is his water-parting marked by any defined physical feature that it was only after some difficulty that Trotter discovered it at a height of 420 feet above the level of lake Victoria. There is also reason to believe that the greater Kára-kul once gave off at one end a feeder to the Káshgár-darya of the Lob-Nor system, and at the other a feeder to the Oxus. We have already seen that it is but a little difference in perpendicular height that determines the drainage between the Satlaj and Karnáli and between the Nubra branch of the Shayok and the Kárakash, so that where rivers have their sources in these elevated areas it may be generally stated that a slight inequality in the surface, such as it is not possible to delineate on any ordinary map, is sufficient to determine the course of springs into channels that have a very remote debouche one from the other in the plains. The terms trough, channel, basin are in such cases often misleading. Nor are the bounding ranges in these elevated regions marked with such well-defined characters as are met with elsewhere. The great Pámir is divided from the Alichúr Pámir on the west by a range having an average elevation of only 3,000 feet above the level of the

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[1] Lesser Kára-kul or 'black lake.'

[2] The two groups form a part of Hayward's meridional Kizil-Art range, the existence of which was supported by Shaw and Trotter and denied by Fedchenko, who considered the phenomenon described by Hayward as merely representing the terminal butt ends of parallel ranges belonging to the Pámir plateau. Kostenko, however, maintained it to be a great mountain range. Views of the Muztágh-Ata peak and the Karikol valley are given by Gordon in his 'Roof of the World.'

Victoria lake, and from the little Pámír by a similar range averaging about 2,000 feet above the same level. The direction of the rivers depends, therefore, on the influence of much less relatively important masses of matter than are to be found at lower levels. The slight difference in level that determines the course of the head-streams of the Kárakash and Yárkand rivers on the Dipsang plains, is sufficient to divert the former from their normal direction and drive them directly against the Kuen-lun range, where, finding a fault in the wall, they work their way through towards the plains. The influence of the law of gravity and the mechanical and chemical changes wrought by water are the sufficient causes for every form of river channel that is met with, and it is to their ceaseless action that even the stupendous gorges of the Indus, the Satlaj, and the Brahmaputra, are due.

Plains of Hindustán

Indus plain.

Having concluded our review of the river-basins and their relations to each other, we shall now proceed to examine the different parts of the area under our consideration. The great plain of Hindustán which first claims our notice is a vast flat extending with an almost unbroken surface along the foot of the Himálayan slope from the upper Indus to the Bay of Bengal. Its direction is from north-west to south-east over a distance of nearly 1,500 miles, and having an area, including its western branch along the Indus and its eastern prolongation into Asám, of about 500,000 square miles. On the west it has its greatest development stretching along the Indus from the foot of the mountains to the sea, from north-east to south-east for a length of 750 miles. Its breadth from the Arvali hills to those west of the Indus is about 400 miles. The Arvali hills run in a north-easterly direction from the peninsula of Kathiawár until they lose themselves in the plain near Dehli. From this point they run in a south-easterly direction connecting with the Vindhyas, and in both cases constitute the abutments of the elevated plateau of Central India. They thus form two sides of a triangle with its apex towards the north, where it separates the Indus plain from that of the Ganges. The general slope of the Indus plain is south-west, with, as we have seen, a slight depression towards the south, until the influence of the northern slope of the Arvalis is felt, when it gradually rises again. Taking a line along the Indus,[1] we have Sehwan, 117 feet above the level of the sea; Shikárpur, 199 feet; Dehra Gházi Khán, 395 feet; Segra, on the eastern bank of the Indus, opposite Dehra Ismáil Khán, 606 feet; and Khairabad, opposite Kálábágh, 750 feet. Following the 32nd parallel from west to east, we have Sandi on the left bank of the Indus, 629 feet above the level of the sea; Lodri, on the left bank of the Chínáb, 657 feet; and Rámdás, on the left bank of the Rávi, 796 feet: further east, we enter the hills. Following the 30th parallel we find Múre on the 71st meridian, with an elevation of 386 feet; Núr Sháh on the 73rd meridian, 482 feet; and Pakka Saráwa, on the 75th meridian, 698 feet. The perfect uniformity of the surface is broken in the north-west by the small table-land between the Indus and the Jhilam, of which the salt range[2] forms the abutment. These hills at the Sakesir station of the survey in the Jhilam district rise to a height of 4,994 feet above the level of the sea. They extend from Khairabad on the Indus to the Jhilam opposite Chilianwála, and thence those forming the eastern flank of the table-land as well as a subsidiary range to the east of the Jhilam turn abruptly north-east and connect with the outer ranges of the Himálaya near Bhimbar (1,200 feet). The table-land itself is seldom more than two or three hundred feet above the general level of the plain, and presents an undulating though tolerably even surface broken occasionally by ridges which attain a height of from two to three thousand feet.

Indian desert.

The Indus plain along the foot of the hills is sufficiently watered, but to the east and south at any distance from the rivers cultivation on an extended scale is only possible when the scanty rainfall can be aided by artificial irrigation. The latter tract known as the great Indian desert stretches through Bhatiána, Bikanír, and Baháwalpur into Sind. Tradition tells us that in former time it was a fertile and populous country studded with numerous cities and towns and inhabited by prosperous and civilised tribes. A recent writer[3] states that "there is nothing in history to show that the rivers (of this tract) ever contained much more water than they do now. Some diminution in their volume may have taken place during the lapse of ages, from changes in the lower Himálayan range, as well as from the destruction of forests and increase of irrigation. There is no doubt also a tendency to the obliteration of the lower part of their course; partly by the drift of sand and dust from the desert; and partly by the deposit of the silt brought down by the streams themselves, owing to the absence of the great river by which it would have been carried off to the sea." Between the Sarasvati and the Satlaj are a series of broad channels, most of them a mile in width, of which those to the west appear to terminate in the valley of the Satlaj, while those to the east, which are also the more ancient, lead to the channel of the lost river Hakra or Sotra.[1] The Kaggar now runs in an old bed of the Satlaj and was formerly an affluent of that river. The change may have taken place owing to some great cataclysm[2] which formed a new bed for the river and left the old one for its tributaries on the east, and there is much to be said in favour of the identification of the Sotra channel with this old bed. At the present day the water-level in wells in this tract is excessively low, being often so deep as three hundred feet from the surface. As the water when procured is often brackish, it is a matter of wonder that people are found to inhabit this country which long ago received the name of Marusthali, 'the region of death.'

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[1] All these heights are taken from the records of the Great Trigonometrical Survey.

[2] Fleming on the salt range, J. As. Soc., Ben., XXII., 229.

[3] Cal. Rev., July, 1871, p. 3.

Gangetic plain.

The Gangetic plain extends from the debouche of the Jumna from the hills to the head of the delta of the Ganges, and lies between the great bend of the Himálaya and the north-eastern slope of the table-land of Central India, which here has a general elevation of about one thousand feet above the plain. The breadth of the plain varies from about two hundred miles at Agra to about one hundred miles at Rájmahál. The direction is to the south-east, but to the east of the Ganges the courses of the rivers exhibit more southing. A general idea of the fall in height along the course of the Ganges may be obtained from the following figures: Saháranpur, 903 feet above the level of the sea; Meerut, 735 feet; Aligarh, 610 feet; Agra, 516 feet; Cawnpore, 517 feet; Allahabad, 315 feet; Benares, 255 feet; Patna, 174 feet; Bhágalpur, 159 feet; and Bardwán, 97 feet.[3] Cross sections show little difference in height at any point Bhatpura, below Mohan, at the entrance to the principal pass into the Dehra Dún, is 951 feet above the level of the sea. Following eastwards the line along the foot of the hills, we have Hardwár, 1,016 ; Najíbabad 860 ; Barhapura, 910 ; Káshipur, 750 ; Bilahri, 760 ; Sigauli in Gorakhpur, 300 ; Madanpur in Tirhut, 230 ; and Amua, 248 feet.[1] Noting these figures on any good map and following the course of the rivers, a sufficiently correct idea of the general slope of the Gangetic plain will be obtained. At the termination of the hills near Rájmahál, the plain once more expands largely to the south and again presents an uninterrupted surface from the mountains to the sea. The length of this section is about 350 miles, and its breadth from Rájmahál to the Brahmaputra about 150 miles, but increasing to about 300 miles along the coast at the head of the Bay of Bengal. The height varies from 100 feet, the level of the river Mahánadi at Málda,[2] to 75 feet at Jelinghi, the head of the Hugli branch of the Ganges,[3] and 31 feet at Chinsurah. The Howrah station bench-mark is but 18·2 feet above the level of the sea.[4] These portions of the great plain, often though not very appropriately called the valley of the Ganges, are intersected by the countless tributaries of that river and are under the full influence of the periodical rains. They therefore, as might be expected, comprise the richest, the most populous, and the most civilised districts of India, and in these respects form a striking contrast to the western parts along the Indus which are doomed to perpetual sterility, not from any natural deficiency in the quality of the soil, but only from the great aridity of the climate. This barrenness is no doubt, in a great measure, due to the relative position of the Indus plain to the higher ground around it and to the prevailing winds ; matters which, at first sight, appear to be of little importance, but which are the efficient causes of the extremely dry climate that it possesses. Fluviatile action in erosion and deposition, productive of the alluvion and diluvium, terms so well known in the settlement records of these provinces, has clearly directed the course of the rivers in the great Gangetic plain. Mr. Fergusson, in an article quoted by the authors[5] of the 'Manual of the Geology of India,' shows that the rivers of the Ganges delta oscillate in curves, the extent of which is directly proportional to the quantity of water flowing down their channels. Thus, the oscillations of the Ganges between Mungir and Rájmahál average 9½ miles, and between Allahabad and Chunár, only 3·7 miles in length. Further, when a great river runs through a low country, its course is considerably stayed by the sluggish expanses of stationary water generally termed *jhíls* in Bengal, and it is thus compelled to deposit its silt along its banks. Hence arises the phenomenon of a river passing through a country between banks that are higher than the adjacent alluvial flats, and the gradual increase of the banks until the stream makes its way through them to some lower level. Mr. Fergusson estimates that when the slope of a river bed falls to less than six inches in a mile, a denuding river will be converted into a depositing river, and as the deposit commences at the bottom of the slope, the change proceeds up-stream. Moreover, since the Ganges receives its more considerable affluents from the north, the left bank gradually increases and drives the main stream more and more towards the table-land of Central India, and makes the point of confluence of its affluents continually move upwards. This tendency is well marked in the Jumna in the Mainpuri district, where the old silted-up bed is locally known as the *bhagna*.[1] In the Tarái below Kumaon the same law prevails, and streams that in the upper portion of their course are denuding rivers in the lower portion where the check in slope occurs deposit their silt, form jhíls, and continually change their courses like the rivers of the Gangetic delta.

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[1] Said to have dried up in the thirteenth century.

[2] Like that of 1762, when, according to General Cunningham, the river was dammed up by a landslip in the hills and rose some four hundred feet before the barrier gave way. A similar cataclysm occurred on the Indus.

[3] From G. T. S. tables.

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[1] First five from Webb and Sigauli from Kirkpatrick.
[2] Hooker.
[3] Prinsep.
[4] G. T. S., 52 in sc. VIII., 1866.
[5] Pp. 406, 412.

Asám valley.

The Asám valley forms a narrow prolongation of the eastern extremity of the plain, partaking more, however, of the nature of a simple river valley liable to annual floods. It has a length of about 300 miles with a breadth of thirty to forty miles, widening at its junction with the

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[1] Gaz. IV., 478 The old bed in Sahâranpur is called the Budhi Jumna.—*Ibid*, II., 110. Remains have been found in the Jumna alluvion near Allahabad.—J. A. S., Ben., III., 302, 529; IV., 262, &c Wilford also notices the discovery of bones of men and animals in the Ganges alluvion near Benares about a furlong from its present bed at ninety-five feet from the surface and thirty feet below the level of the present bed He says the human bones were entire, but those of quadrupeds were broken and bore evident marks of their having been cut with a sharp instrument He found no marine deposits at over 105 feet when the water-bearing strata was reached.—As. Res., VIII., 291. He has also noticed the fact that the point of junction of the Kosi with the Ganges had moved up from Nawábganj opposite Rájmahál some twenty-five miles.

Gangetic delta. It is shut in on all sides, except the west, by mountains. The characteristic of a sudden and total change along a definite line at the foot of the mountains from a broken hilly surface to an absolute flat, which holds good throughout the other parts of the plain, here no longer prevails. We frequently see small isolated hills standing out like islands from the general level surface, a phenomenon observable on a smaller scale where the Vindhyan range mingles with the plain. From Sadiya, which is 440 feet above the level of the sea, the fall is gentle to Gauhati, which is placed at 163 feet, and Goálpára, which is 150 feet.[1] Taking a line along the foot of the hills, we have Titaliya, 330 feet; Rájhát at the foot of the hills near Buxa, 220 feet; and the station at the foot of the hills below Diwángiri, 670 feet: figures[2] which show a more sudden descent than those at similar positions under the western Himálaya.

Bhábar.

We shall now return to the plain between the Jumna and the Sárda, and more particularly to that part which lies immediately below the foot of the Kumaon hills. We find there a narrow belt of country usually covered with forest and remarkable for the entire absence of water, a phenomenon eminently characteristic of this tract. The great rivers *preserve their course with some diminution in their volume, but all* the minor streams that have their origin in the lower hills on entering this belt soon lose themselves in the shingly deposit that constitutes the substratum. In time of flood, however, they often preserve a visible stream throughout their course, but this appearance lasts only so long as the cause exists. This belt of waterless forest land is called the Bhábar or *ukhar bhúmi* (waterless forest) under Kumaon, and has a breadth of from five to fifteen miles. Though no stream or spring exists, the Bhábar is clothed with a magnificent forest finding its nourishment in the few feet of alluvial matter that rests on the boulder and shingle deposit below.[3] To the

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[1] These figures are from the Great Trigonometrical Survey records, which make Dibrugarh, 348 feet above the level of the sea; Sibságar, 310 feet, and Barunak, near Tezpur, 256 feet.

[2] First from Hooker, two last from Pemberton.

[3] These descriptions are chiefly based on Herbert's report, and on an article entitled 'The Himálaya in Kumaon and Garhwál' by Mr. (now Sir John) Strachey, Cal. Rev. No. 35. Stewart notes that he can find no definite statement as to the breadth of the tract known as Bhábar and Tarái to the east of Sikkim, but Hooker mentions expressly that there it ranges from 8 to 12 miles in width; Kirkpatrick and Hoffmeister coincide in making its breadth opposite Nepál about 10 or 12 miles, and between the Sárda and Rámganga it ranges from 20 to 30 miles, falling to 6 or 7 miles abreast of Garhwál and disappearing to the west of the Jumna.

Tarái

south of the Bhábar, the character of the country changes into a swamp devoid of trees and intersected by sluggish streams that rise from unhealthy morasses. This tract is included with the Bhábar between the Ganges and the Phíka under the general term *ban* or jungle. East of the Phíka under Kumaon, where it apparently attains its maximum breadth, it is known as the Tarái, and under Nepál as the Taryáni, with some specific addition as Morang, &c. It lies between the forest belt and the cultivated plains, with an average breadth of about ten miles under Kumaon, though varying much in different parts. Thus we have between the plains proper under Kumaon and the foot of the hills two distinct belts of country, each about ten to fifteen miles broad, known as the Tarái and the Bhábar. The Tarái is characterised by the presence of reeds and grasses showing the marshy nature of the ground. The streams carry off only a portion of the superfluous moisture and sluggishly run in tortuous channels, doubling back constantly in their course. The soil consists of moist alluvial matter without a sign of rock either in fragments or in site. In the Bhábar, on the other hand, no water rises from the ground. Throughout its whole extent not a single spring nor any water can be seen, except occasionally where one of the larger rivers takes its course. In the rainy season alone torrents cut into the ground, and the channels thus formed exhibit characteristic sections of this remarkable tract. We then find that there is but a thin covering of alluvial soil on a vast dry bed of boulders and of shingle, through which all rain that falls sinks rapidly, and which absorbs in the same way all the minor streams of the outer ranges. Instead of reeds and grasses, we have here all the magnificence usually attributed to oriental forest scenery. Gigantic *haldús (Adina cordifolia)* and *khairs (Acacia catechu)* rear their heads above a tangled undergrowth of creepers and thorn-bushes which present a barrier to progress that an elephant alone can surmount. Towards the hills we find the *sál*[1] *(Shorea robusta)*, and in Kota great groves of mangoes, while patches of cultivation appear wherever irrigation is practicable. For this purpose, the streams of the lower hills are turned into artificial channels before they reach the shingle deposit, and even the lakes in the lower hills are dammed up to retain a sufficient supply of water for the Bhábar. West of the Kosi, however, there is little cultivation or irrigation, and the Bhábar there almost remains untouched by the plough. The actual slope of the ground between the Tarái and the foot of the hills is considerable, though not apparent to the traveller, except when he observes the rapidity of the current in the irrigation channels that line the road by which the Bhábar is crossed.

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[1] The *sál* is the characteristic tree of the upper Bhábar wherever it is found. Hodgson notes that constant observation has enabled the people of the Tarái to distinguish the principal belts of the Bhábar from the trees that grow in each. The highest is the *sál* level, the next is the *khair* level; and the lowest is the *sisu (Dalbergia sisu)* level

Siwáliks

Before entering into more detail regarding the Bhábar and Tarái, there is yet a third feature characteristic of the tract below the Himálaya that must be noticed here as intimately connected with the other two, and this is the line of hills called the Siwálik[1] or sub-Himálayan. These will be well known to palæontologists in connection with the rich collection of fossil mammalian bones discovered in them by Dr. Falconer and Colonel Cautley. As a rule, they appear to rise abruptly and without any intermediate undulating slope from the apparently level surface of the flat country below to heights varying from a few hundred to three or four thousand feet. They are composed of sandstones and conglomerates, and the dip of the strata is usually towards the general mass of the mountains at a low angle. The form of disturbance of the strata is very regular, producing broad normal anticlinal flexures, the axis-plane sloping towards the mountains. Towards the plains the slope has been weathered out, so that plainswards the Siwáliks exhibit a steep face from which rise the highest summits of the range, while a long gentle declivity slopes inwards and forms a longitudinal shallow valley by meeting the foot of the next line of hills. The latter, as a rule, run on a line parallel to the Siwáliks, but at a distance of from five to ten miles from them.

Dúns.

The bottom of this longitudinal depression is, as may be supposed, by no means continuous. In some places it is cut through by the passage of the streams that drain the interior of the mountains ; in others, it is quite obliterated by the near approach to each other of the two ranges that flank it, and which usually form distinct lines. This is, moreover, a structural feature and not due simply to denudation. In the country between the Satlaj and the Káli, these valleys are called Dúns and under Nepál, according to Hodgson, they are called Máris. They have been confounded by some writers[1] with the Tarái, which, as we have seen, is quite distinct. The lower part of the Dúns generally appears to be covered with a deposit of boulders and gravel that slopes somewhat steeply from the Himálaya towards the Siwáliks, so that the whole bottom of the valley is considerably raised above the level of the plain without. In consequence of this elevation, the outer hills when viewed from the interior of the valley, as from Masúri, present a very insignificant outline. The drainage of these valleys usually collects along their longitudinal axis and either falls into some of the larger streams that cross them, or less frequently finds an independent exit for itself into the plains by a sudden bend to the south through a break in the outer range. Owing to the considerable elevation of the Dúns above the plains down to the level of which the drainage finds its way in a very short distance, the unconsolidated strata that form the floor of these valleys are constantly cut through to a great depth by water-courses. Consequently, the surface, though often presenting an apparent flat for several miles together, is frequently broken up into steps which, on the whole, are tolerably level, but at different heights, the one above the other. This phenomenon is not uncommon, and is constantly observed along rivers that are eroding their banks. To the same causes also are to be attributed the practical impossibility of procuring water by means of wells in the Dúns, a difficulty which mainly arises from the thorough dessication of the gravelly soil by the deep drainage.

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[1] Siwawála, belonging to Siva ; for use of the term 'Siwáliks' by Musalmán historians, see 'History' *postea*.

Extent of the Bhábar.

We have not sufficient information to state distinctly how far the Bhábar extends both east and west along the foot of the Himálaya, but the following indications would lead us to suppose that this phenomenon is inherent in the relations of such a mass as the Himálaya with the subjacent plains. Under Nepál it is called the Jhári or Bhávar, and, according to Hodgson,[2] extends from the Káli to the Mechi on the east with the same general characteristics as under Kumaon.

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[1] Somerville's Physical Geography corrected in 7th edition, 1878.

[2] Physical Geography of the Himálaya.—J. A. S., Ben., XVIII., 778.

Eastward of the Tista, according to the same writer, the Bhábar and Tarái do not exhibit the same parallelism to the line of the Himálaya, but "show themselves plainwards, like an irregular series of salient and re-salient angles resting on the mountains. Or like small insulated plateaus or high undulated plains, surrounded in both the latter cases by low swampy land analogous to the Tarái." An example of the former is found in the plateau called the Parbat Joár on the confines of Asám and Rangpur, which is considerably elevated, quite insulated, remote from the mountains and covered with *sál*, the characteristic tree of the upper Bhábar. Again, we have undulating plains, such as those that occur around Dinajpur and to the north-west and north-east of Siligori, all of which may be identified with the Bhábar. In all these cases where the detritus bed thins out, a moist tract is met with, though in no case so marked as to the westward. Herbert[1] affirms the general applicability of his remarks regarding the submontane tract below Kumaon to the entire country between the Ganges and the Satlaj and Parish[2] to the tract further west between the Satlaj and the Biás. There is no well-defined line dividing the area of swamp from the Bhábar proper between the Sárda and the Rámganga. To the east in the Tallades Bhábar, where the streams seek the Sárda directly, there is less Bhábar, and the swamps that exist are not so extensive, but at the same time are more formidable, being often surrounded by tangled masses of canebrake. The Dhyánirau Bhábar also is comparatively narrow, and it is not until we come to the Chhakháta Bhábar that we get a breadth of eight to twelve miles that lasts until the Phíka river is reached. The Tarái exists all along the tract to the south of, and parallel to, the Bhábar from the Sárda to the Phíka. But west of the Phíka it loses its characteristics and can only be traced in the closeness to the surface of the water-level in wells. Westward of the Phíka, the Bhábar or waterless tract also narrows and the *sál* forest does not descend more than six miles from the foot of the hills, and a few miles further west it has not a breadth of two miles. The Bhábar, however, exists, and is broader than the present *sál* forest, of which much has been cut down of late years. Its presence is shown by the absence of wells, and similarly the Tarái appears in a line of wells with water at from three to six feet from the surface, running parallel to and bordering on the Bhábar. This limitation of both the Bhábar and Tarái is conterminous with the commencement of the Pátli Dún, which has detained the greater part of the detritus that is elsewhere spread out below over the plains. From the Phíka eastwards to the Sárda, where these tracts attain their maximum importance, there are no Dúns, properly speaking; for the Kota Dún presents no great barrier to the south, and further east the Siwáliks are so blended with the outer range that a geologist alone can trace their sequence. In this fact, we have an illustration of that portion of Hodgson's theory that gives a narrow extent to the Bhábar below the Dúns and a broader range where there is no Dún to intercept the débris from the hills. The facts that we know regarding the Bhábar to the north of the Saháranpur district[1] further confirm this deduction.

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[1] Report of the Mineralogical Survey of the Himálaya Mountains, *Ibid*, extra No., Vol XI. [2] Kohistán of the Jullundhur Doab, *Ibid*, XVII., p. 281 XVIII., p. 360.

The Bhábar in Turkistan.

In Eastern Turkistan we find a similar phenomenon. Trotter tells us that the Sagon river, which has its source at the eastern foot of the Terek pass, after it reaches the plains north of Kalti Ailak wastes away and leaks through crevices in the stony ground. The hákim of the latter place assured him that wells had been often sunk but proved of no use. Trotter writes :—"This diminution in the size of rivers as they descend is one of the chief characteristics of the country, and occurs in all minor streams that have come under my notice. Of course much of this is due to irrigation, which necessarily carries off large quantities of water, but the stony soil has also much to answer for; on the other hand, the frequent appearance of large springs giving considerable supplies of water and often issuing from the open plains at long distances from the mountains may account in a great measure, if not fully, for the water thus lost in its early infancy." Here we have the existence of a Bhábar and Tarái vouched for by competent authority in the Yárkand and Kashgár country. The same phenomenon, but on a larger scale, was found by Prejevalsky to characterise the tract between Korla and Lob-Nor. A belt of country about three to four miles wide, consisting of an undulating plain covered with a pebbly or gravelly soil and totally devoid of vegetation, runs parallel to and at the foot of the Kurugh-tágh, a low waterless and barren range. Beyond this stony margin, which appears to define the shore-line of an ancient sea, lies the great desert of drift sand amid which salt marshes exist wherever the moisture comes to the surface. The same pebbly plain was found under the northern slope of the Altyn-tágh, the north-easterly continuation of the Kuen-lun mountains between the 90th and 92nd meridians, and north of and below the stony margin the usual salt marshes occurred. The latter are also found at the foot of the north-eastern portion of the Tibetan table-land in Tsaidam. It would, therefore, appear that tracts analogous to the Bhábar and Tarái of Kumaon surround the entire Himálaya-Tibetan mass, and that they vary in character according to local influences.

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[1] Gazetteer, II., 140.

Cause of the deposit: Hodgson's oceanic theory.

Hodgson attributes the distinctive character of the Bhábar, as a whole, "to the vast mass of diluvial detritus which was shot from the mountains upon the plains, like gravel from a cart, at some great geological epoch, and which has been, since its deposit, variously and often abraded both in degree and direction by oceanic and, in a far less degree, by ordinary floods." Another writer considers that this theory of Hodgson's appears to be a reasonable explanation of the existence of these great beds of shingle, sand, and boulder all along the foot of the mountains. It is argued that no rivers can have laid out such a vast deposit, and we can only conclude that we see here the limits of an ancient ocean that once washed the base of the Himálaya. The boulders and shingle are spread out only for a distance of ten or fifteen miles from the mountains from which they are derived, while the finer particles of sand and clay are carried much further. Great variations in the depth and breadth of the deposit occur, due, in a great measure, to local causes. One which apparently has had a great influence is the existence or otherwise of the Siwálik range. Where there was no sandstone range to intervene between the mountains and the plains and collect the detritus within their contained Dúns, the deposit is broader and not so thick. Where there was such a barrier, it has been carried less southwards and exists in great accumulations between the barrier and the mountains. Again, where no range existed but only spurs sent forth, like bent arms, upon the plains from the mountains, Hodgson observes that the embayed detritus is simply deeply piled and lofty within such spurs, and thinly and unequally spread without them, by reason of the action of the spurs on the current. He notices, as an example of this form, the débris embayed by a spur on the road to Darjiling by Pankabári, where it is accumulated to several hundred feet, and where, moreover, there is outside the spur a succession of terraces, apparently due to oceanic forces.[1] Further, "where, as from Gauhati to Sadiya, there was not room upon the plains for the free spread and deposit of the detritus owing to large and rapid rivers and to other chains both proximate and parallel to the Himálaya, the phenomena, created elsewhere by the more or less unrestricted spread of the Himálayan detritus over the plains, would necessarily be faintly, if at all, traceable. Lastly, if at the time of the descent of the débris, there existed a great dip in the Gangetic plain from north-west to south-east, the lithologic character, as well as the distribution of the débris, would be materially affected thereby, for the subsiding oceanic current would have a set from the former to the latter quarter and would continue to lash the gravel into sand and here to deposit both in a series of terraces, there perhaps utterly to displace both in the latter quarter long after the former had emerged from the waves."

Fluviatile theory.

The oceanic theory of Hodgson is not accepted by the majority of professed geologists. Mr. W. Blandford writes:[2]—"There is absolutely no proof of any sort or kind that the whole Indo-Gangetic plain has at any time been a marine area; but there is equally no proof that it has not. It has been shown that in eocene times the sea occupied the Indus valley as far as the foot of the Himálaya, and extended along what is now the base of the mountains, as far east as Kumaon; and also that marine conditions prevailed to the north-west throughout a great part of the tract now occupied by the Asám range; but it was also pointed out that, in the area between Kumaon and the Gáro hills, no trace of marine formations had been found. Yet it is difficult to understand, if the Gangetic plain was a sea-basin, why no marine beds occur. It is true that the northern border of the plain, throughout the most important part of the intervening space in Nepál, is, unfortunately, inaccessible to Europeans; but still, if the Gangetic plain in any way corresponds to an eocene sea, as the Indus plain doubtless does, why are no traces of marine beds found to the south of the valley on the margin of the peninsular area, as they are in the desert to the east of the Indus? In the Brahmaputra plain, also, no marine deposits of tertiary age are found; in the plain *itself only fluviatile deposits have been* detected and the marine, eocene, and miocene beds are confined to the southern slope of the range forming the southern watershed of the valley." Mr. Blandford considers the post-tertiary formation of these provinces to be clearly river deposits. The latter tertiary formations belonging to the Siwálik series contain reptilia and mollusca, but not a single marine shell. "It is impossible to tell what beds may be concealed below the Indo-Gangetic alluvium, and marine strata may exist to an enormous extent without appearing at the surface; it is also unquestionable that the amount of information hitherto derived from bórings is very small indeed, but so far as that information extends, and so far as the lower strata of the alluvial plain have been exposed in the beds of rivers, not a single occurrence of a marine shell has ever been observed, nor is there such a change in the deposits as would render it probable that the underlying stratra are marine * * . The only evidence known in favour of marine conditions having prevailed during the deposition of any portion of the Gangetic alluvium is the occurrence of brine springs at considerable depths in a few localities. These springs, however, are not numerous, and, without additional evidence, it is impossible to look upon them as proofs of marine deposits. At the same time it is by no means impossible that the sea occupied portions of Sind and Bengal long after the plains of Upper India were dry land." On the whole, Mr. Blandford thinks that the oceanic theory wants further support; that the fluviatile theory is the only one that fits in with the present state of our knowledge, and that the depression of the Gangetic plain is of contemporaneous origin with the *disturbance and contortion of the* Himálayan ranges, and that the physical features of the two areas are closely connected. No important borings have ever been made in these provinces, and nothing has ever been discovered, so far as we are aware, to show that the older theory is the correct one. The newer theory is further supported by the discovery of the buried town of Behat in the Saháranpur district, some seventeen feet below the present level of the country and containing coins of the commencement of the Christian era, thus showing what can be effected by fluvial action in eighteen centuries.

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[1] The oldest advocate of the oceanic theory is Wilford (in As. Res, VIII., 292), who thus accounts for several statements made by the Paurának geographers, and particulary the story of Sagara. He, however, acknowledges that the existing soil of the Gangetic plain, so far as is known, was due to fluviatile action.

[2] Manual of Geology of India, p. lx., 393.

Tarái.

We have already seen that the distinctive features of the Tarái are not found west of the Phíka river, if we except a small tract on the left bank of the Rámganga, the condition of which, however, is probably due to defective drainage in that particular part, and might occur in any other place. The existence, therefore, of the Tarái as a distinctive feature must be due to local causes capable of explanation, but the imperfect nature of our knowledge will only allow us to guess at them. Herbert[1] described the Tarái as "defined in its southern boundary by a rise or step which runs parallel to the common boundary of mountain and plain land." He observes the height is variable, occasionally as much as thirty feet and sometimes sudden and steep. Modern research can discover no well-defined boundary beyond the chain of springs which sometimes approach within a couple of miles of the foot of the hills and sometimes are separated from them by a belt fifteen miles wide. In no case is there any such rise or step as described. Hodgson[2] also accepted the existence of a longitudinal trough running parallel to the Himálaya as a characteristic of the Tarái, which he held to be a natural depression in the plain, and thus accounted for its peculiarities. This theory, however, is opposed to the results obtained by levelling operations and appears to be based on an entirely erroneous idea, the fact being that the drainage of the higher country, beyond which has been lost in the absorbent strata of the Bhábar, here breaks out again in a line of copious springs which collect into swamps in the Tarái. This feature has also somewhat plausibly been accounted for[3] by the existence of an impervious stratum below the absorbent boulder detritus, and as the latter gradually thins out the finer and less permeable silt underlying it approaches nearer, and eventually reaches the surface, bringing with it the water that has been absorbed by the shingle talus and has been retained by the impervious silt.

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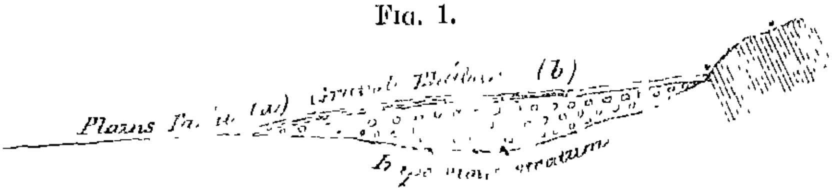
[1] *l. c.*, art. 73. [2] *l. c.*, p. 788. [3] Batten in Kumaun Reports, p. 184.

FIG. 1.

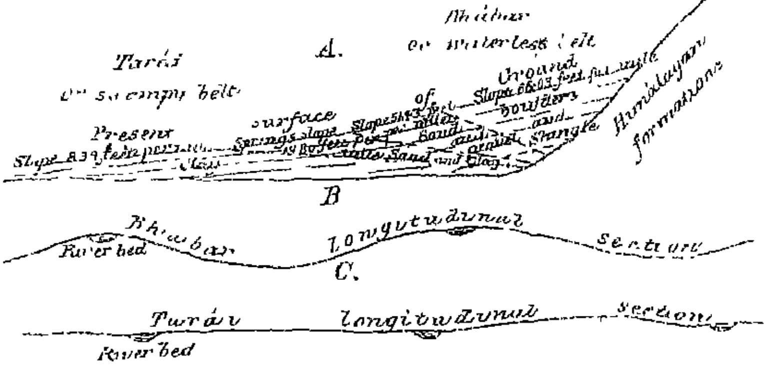


(*a*) Point of re-appearance of water. | (*b*) Point of disappearance of water.

Although this explanation seems reasonable so far as it goes, it must be remembered that the swampy Tarái extends only from the Phíka to the Tísta, and we must, therefore, look for some peculiarity in this part of the plain which does not exist elsewhere, by which we may account for the existence of swamps exclusively in this particular locality.

In a recent note, Mr. Lawder gives the following section of the Bhábar and Tarái :—

FIG. 2.



His experience of this tract has led him to consider that, whatever may be the nature of the underlying formation, the surface beds are solely due to fluvial action. The mountain torrents along the foot of the Kumaon hills bring down every year a vast amount of débris which is spread out over the surface now on one side of their previous course and again on the other. This irregular deposition itself compels the torrents to change their beds from place to place until, as now obtains, the points where they debouche from the hills are marked by more or less irregular, great, fan-shaped boulder and gravel deposits. The clayey or semi-soluble particles are necessarily carried farthest and are readily deposited not only where there is a check in the slope, but where the current is impeded by the tortuous nature of the channel which itself naturally assumes that form under these conditions. Here, during the rains, the streams saturated with clayey silt, overflow their banks, form new channels, fill up old ones, and create the Tarái. Above this deposit of clay we find one of clay combined with sand, in which, however, the latter predominates. From this bed issues the line of Tarái springs that flow uninterruptedly throughout the year, and its margin marks the northern boundary of the Tarái. Above we meet beds of sand and gravel or gravel and boulders as we approach nearer to the hills. A longitudinal section taken at the top of the Bhábar (Fig. 2 B.) will show that the hill torrents in the upper portions of their course run along a ridge formed by the débris transported by themselves, whilst a similar section of the Tarái (Fig. 2 C.) would show that, as a rule, the river channels are found in depressions below the general level of the country. The geological section (Fig. 2 A.) shows the gradients of the present ground surface on the road between Bareilly and Ránibágh, and from them it will appear that in the boulder region deposition takes place at a slope of sixty-six feet to the mile, whilst the clay is not deposited until the descent falls to about eight feet in the mile. It may fairly be assumed that these are the usual angles of deposition of the materials, and that they have obtained since the degradation of the lower hills and the resulting deposition below them commenced. If so, a series of proportionate curved lines running almost parallel to the present ground surface may be taken to represent the ground surface of succeeding periods, and such portions of these lines as may be similarly inclined with the present Tarái portion (*i.e.*, at the same angle with the horizon) will evidently represent the Tarái or clay deposit as it then existed. A line intersecting all these beds at the several points of junction of the 'clay' with the 'sand and clay' will represent the present impermeable bottom of the Bhábar basin and account for the line of springs upon the surface where the stratum of sand and clay crops out. The upper boulder and gravel beds permit of the filtration of water freely through them to the clay, at the same time acting as a capillary reservoir to keep up the dry weather supply to the springs below.

We have further evidence in support of this theory in the fact that the Tarái proper does not extend westwards of the Phíka river.

Between the Phíka and the Sárda there are no Dúns, for the Kota Dún has its southern boundary broken through by rivers, and along the entire tract numerous torrents find their way directly to the flat country below. The proximity of these torrents to each other causes the accumulation of débris to exhibit a continuous appearance which seems to have suggested the theory of a marine origin. To the west of the Phíka river, the drainage of the lower hills is carried off mainly by streams which collect the drainage within the Sub-Himálayan range and seek the plains in one well-defined channel. The Rámganga is the great arterial drainage channel for lower Garhwál, and between it and the Ganges, the only considerable stream is the Khoh, which has a small strip of Bhábar below it. In eastern Kumaon the Ladhiya serves a similar purpose, and where in its course towards the Káli it approaches the plains and does not allow of any considerable stream from the southern face of the outer range, both Bhábar and Tarái are narrow, and as this influence of the Ladhiya on the east and the Rámganga on the west decreases the Bhábar and Tarái increase and eventually attain their maximum breadth where that influence is least felt. Where rivers discharge large volumes of water like the Ganges and the Sárda, and in a lesser degree the Rámganga and Kosi, the velocity at their debouches *from the mountains is much less than that of the minor torrents*, owing to their having cut back and more deeply their channels within the hills, so that only the lighter particles of eroded matter are carried onwards, whilst the boulders are left behind at their natural point of deposition. Hence, near these larger rivers it curiously happens that the width of the Bhábar and Tarái contracts in a certain ratio and in the case of the Ganges disappears.

This explanation is supported by the results obtained during the contour survey of the Tarái.[1] The second diagram[2] (Fig. 3) shows a portion of the country between the Dhora river and the Bhúta *stream, taken from the survey maps, and will illustrate the* intricate nature of the levelling operations, and show why in some places the streams double back on their original direction and exhibit the tortuous courses so characteristic of this tract:—

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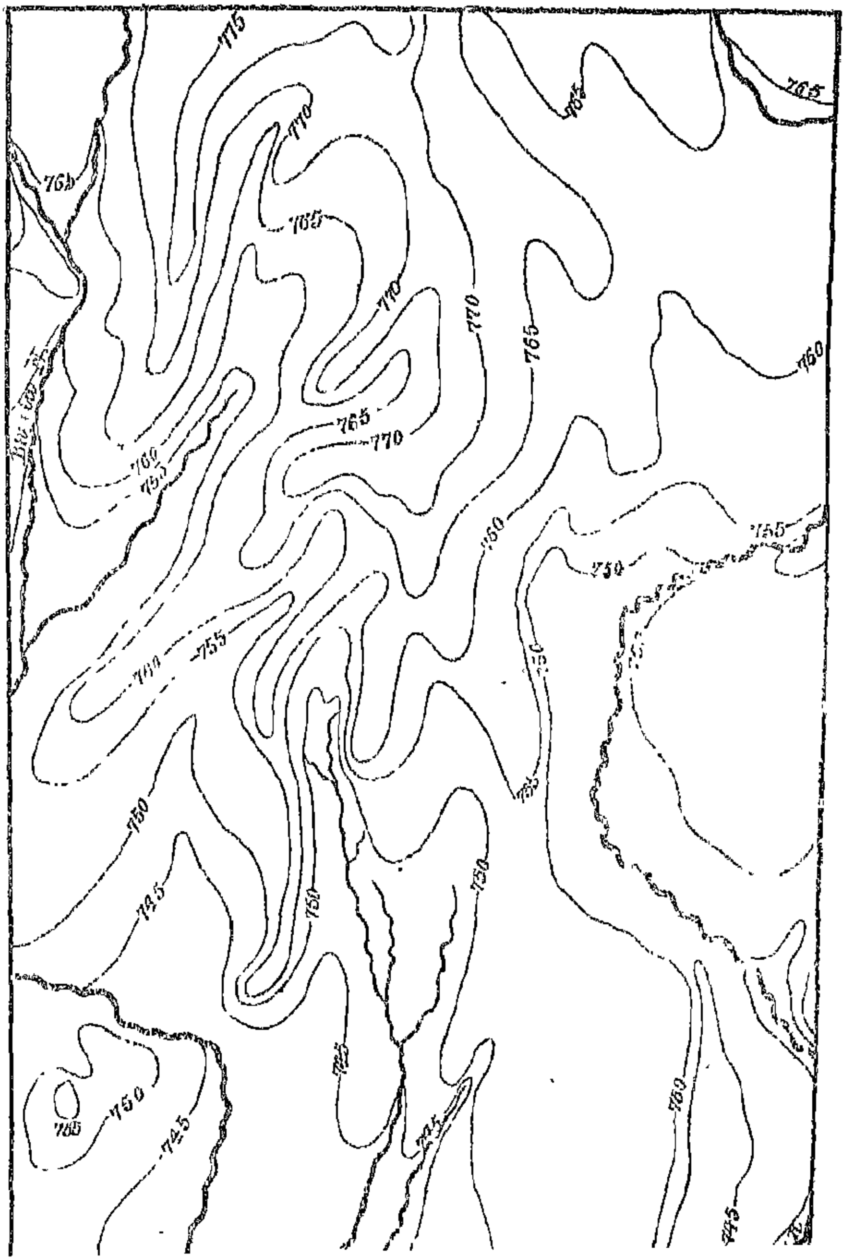
[1] See Proceedings, N.-W. P., P. W Department, May 31, 1864; July, 1869; February, 1872.

[2] From the Rohilkhand remodelled canals' contour map of a portion of the Tarái surveyed in 1865-67 by Captains Thomason and F. Brown and Lieutenant Bisset An examination of the records of this survey shows that what is stated regarding the portion noticed here is true also of the entire tract between the Phíka and the Sárda.

Fig. 3.



It will also be observed that there is a sudden check in the slope where the Tarái commences; to the north in the Bhábar the slope is from sixty to a hundred feet in the mile, and in the Tarái it falls to about ten feet. These are the adequate causes of the existence of swamps, and though the neglect of artificial obstructions made for the purpose of utilising the water for irrigation may doubtless aggravate the natural defects of drainage, it would probably produce no effect whatever were it not for the peculiar physical conditions that exist here. To the west between the Indus and the Ganges, the great arterial drainage lines collect within the hills and run off directly from them, the general fall of the surface receiving no such check as is found under Kumaon. The same is true of the country to the east along the head of the Bay of Bengal, and in the narrow valley of Asám, the Brahmaputra runs in a deep bed at right angles to the natural course of the streams from the hills, and thus forms a perfect system of cross-drainage that does not allow of the formation of swamps.

Siwáliks.

The Siwáliks appear to have a more or less definite existence along the whole of the Himálaya from the Indus to the Brahmaputra, presenting modifications of the same general features along the entire line. To the eastward of the Tísta they are wanting locally, a fact which it has been suggested is due to denudation as in the case of the partially obliterated barrier to the south of the Kota Dún. As the Siwáliks will be noticed hereafter in the chapter on the geology of Kumaon, we need not describe them here.[1] Between the Jumna and the Sárda they are found as the southern boundaries of valleys as far eastwards as the Nihál river, and thence onwards they almost coalesce with the outer range of the lower Himálaya.

Dúns

Of the Dúns or valleys, between the Siwáliks and the Himálaya, that known as 'the Dún' or Dehra Dún, from the town of Dehra, is not only the most remarkable but the best known. Since the physical geography of this tract will be considered *in more detail hereafter*, in the notice of the Dehra Dún district, it will be sufficient for our purpose here to note that the Dún, a little to the west of the town of Dehra, is divided by a ridge that serves as a water-parting between the Asan, a tributary of the Jumna on the west, and the Suswa, a feeder of the Ganges on the east. The tracts drained by these rivers are known respectively as the western and eastern Dúns. The two taken together have a length of about forty-five miles and an average breadth of eleven miles. The east end of the Dehra base line of the Great Trigonometrical Survey on the extremity of one of the spurs of the Gháti range, about one mile west of Mahobawála, is 1,957·65 feet above the level of the sea: Mahobawála itself is 2,096·56 feet and Dehra is 2,323 feet. The junction of the Suswa and the Ganges is little more than 1,000 feet above the level of the sea, giving a considerable *fall for that stream between Dehra and the* Ganges. A well sunk by Mr. Shore, when Administrator of the Dún, attained a depth of 221 feet before a plentiful supply of water was met with, and even at that depth the nature of the deposit was the same as at the surface.[1] The greatest thickness of the deposit is observed near the central ridge. It thins out to the west and east along the course of the Asan and the Suswa, and, according to Herbert, may be observed in the beds of the Jumna and Ganges resting on sandstone. Next, on the west, comes the Kayarda Dún,

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[1] See also Chaps. XXII.-IV. of the 'Manual of the Geology of India,' and Gaz., II., 46.

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[1] The following table shows the character of the stratum, and is reproduced here from Mr. Shore's notes in the Dehra archives compared with Herbert's record as one of the few notices of this character that we possess.

Feet.	Total.	Soil.	Feet.	Total	Soil.
5	5	Fine black mould, few stones.	9	158	Sand, larger pieces of conglomerate.
4	9	Reddish earth with gravel.			
9	18	Sand, gravel, large stones.	4	162	Do., enormous stones
2	20	Do., with reddish clay.	6	168	Conglomerate and gravel.
3	23	Stiff reddish clay	3	171	Sand, gravel, and conglomerate.
8	31	Do., yellow clay.	3	174	Blocks of conglomerate.
3½	34½	Sand, gravel, little red clay.	3¾	177¾	Sand, gravel, conglomerate.
1½	36	Stiff reddish clay.	4¼	182	Do., gravel.
2	38	Sand and gravel.	⅓	182⅓	Conglomerate.
22	60	Stiff red clay.	2⅔	185	Sand and clay.
2	62	Clay, sand and gravel.	18[illegible]	201	Loose sand and gravel and large blocks conglomerate.
16	78	Sand and gravel			
12	90	Stiff yellow clay with little sand.	5	209	Sand, gravel, very moist.
			⅓	209⅓	Conglomerate, over half.
35	125	Sand, gravel, few round stones.	1⅔	211	Red clay
6	131	Sand, large conglomerate blocks.	7	218	Sand and gravel
13	144	Do., gravel, stones,	3½	221½	Brackish clay with angular fragments of clay slate
5	149	Do., larger stones.			

Another well in Dehra gives water at a depth of 88 feet from the surface, and one at Sati-bágh at 75 feet. There are only twenty-nine wells in the whole valley, and many of these are at favourable places near rivers. so that the difficulty of procuring water by this means is common to the whole Dún. Herbert records the some six miles broad and twenty-five miles long, to the water-parting between the Jumna and the Kaggar systems. Beyond it we have the Pinjor Dún, which has in parts a breadth of six miles and a length of about thirty miles. The Siwáliks here are neither so broad nor so high as to the south of the Dehra Dún. The Pinjor Dún is divided into two parts, the eastern and western Dúns, by a ridge similar to that observed in the Dehra Dún, and which attains an elevation of 2,102 feet[1] above the level of the sea. To the east, the drainage flows into the Kaggar, and to the west into a tributary of the Satlaj. Mansi Devi, a temple in the plains just within the Dún, has an elevation of 1,263 feet,[1] giving a fall to the rivers within this Dún similar to that found to exist within that of Dehra.

Ganges to the Brahmaputra.

East of the Dehra Dún we have the Pátli Dún, also divided into two parts, but by a depression, not a ridge, a fact possibly pointing to its being a valley of denudation. That to the west, which is drained by the Sona nadi, has a slope eastwards parallel to the Himálaya, and is known as the Kotri Dún. That to the east, which is drained by the Rámganga and has a slope to the west in the same direction, is called the Pátli Dún. *The two rivers meet just before their waters take a bend to* the south at an elevation of about 950 feet[2] above the level of the sea. A few miles eastward of their confluence, the valley of the Pátli Dún shows an elevation of 1,200 feet on the right bank of the stream, and thus allows a considerable fall to the Rámganga in a comparatively short horizontal distance. The peaks of the Siwáliks to the south along this entire line seldom rise above 2,500 feet, whilst the plains at their southern base average between eight and nine hundred feet. Further east comes the small Kota Dún between

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result of borings made by him in various parts of the tract along the foot of the hills. At Káshipur, in a spot some twenty feet below the surface of the red clay, he obtained the following results —

2'3" superficial red clay; 1'3" green sandy clay, water; 4'6" black clay, extremely tenacious; 1'6" light blue sand and abundant water. At Haldun, seven miles north, nearly similar results were obtained —5'6" a ferruginous sandy clay or loam, latterly becoming more stiff; 1'6" a greenish clay, becoming blackish below; 2' a bluish-grey clay, partially sandy, not so tenacious, and quite moist. At Jaspur, nine miles north-west of Kashipur, he found :—5' surface sand, which gradually changed to a stiff red clay; 2' a red, loose sand, damp; 2' variegated sand and clay, spotted; 3' yellowish sand changing to light grey; twigs and roots were found at nine feet and water at twelve feet. At Afzalgarh 6' superficial loam with small nests of imperfectly formed lignite; 2'6" red sand and a quicksand; 4' blackish stiff clay, and 3'6" stiff clay, latterly sandy. Two other borings are recorded without mentioning the locality.

[1] Herbert, *l. c.* art. 63. [2] G. T. S.

Dhikuli and Káli-dhúngi, much broken up by torrents, and having its southern boundary cut through by the various hill streams that cross it at right angles. From Naini Tál to the Sárda the sandstone ridge that represents the Siwáliks is so close to the Himálaya that the geologist alone can discern the connection. The Dúns are here reduced "to deep longitudinal gorges and low gaps, corresponding with a leading geological boundary, that between the old slaty and schistose rocks of the mountains and the massive tertiary sandstones of the Siwáliks." Further east, according to Hodgson, the Dúns are represented by the Saliyán Mári, the Gongtáli Mári, the Chitwán Mári, the Makwánpur Mári, and the Bijayapur Mári, all under Nepál. With the exception, however, of the Dún lying on the road to Kathmándu, none of these have been subjected to scientific examination. "On this track," writes Mr. Medlicott,[1] "very complete representatives are found of the two sub-Himálayan ranges and their intervening *dún* or *mári*. The Chúriagháti range is structurally a facsimile of the original Siwáliks. At the outer base at Bichiyakoh, there are some earthy rusty beds, all greatly crushed. The dip soon settles down to 30° to north-north-west, maintaining the same angle steadily to the top of the pass. This is the typical structure of these detached sub-Himálayan ranges, the flat inner half of a normal anticlinal flexure. The range is about four miles wide." Throughout the Sikkim and Bhután *duárs* there is no representative of the Siwálik hills and therefore no *dúns*, but in the Dikrang basin of the Daphla hills, Colonel Godwin-Austen discovered two well-marked ranges of sub-Himálayan hills with an intervening *dún*. We have now seen that the first characteristic features met with in advancing from the plains to the Himálaya are the Tarái, Bhábar, Siwálik range, and *dúns* or valleys, and that though not continuous and indeed occasionally altogether absent, they are, taking the whole range, characteristic of the relations of the Himálayan mass with the subjacent plains.

Lower Himálaya.

Crossing the Dúns northwards towards the snows, we meet the outer ranges of the lower Himálaya. They have a general elevation of about 7,000 feet above the level of the sea, while the highest summits along the line reach between 8,000 and 9,000 feet. This generalisation, though giving the nearest approach to accuracy that the state of our knowledge permits, is only approximate, for we know very little regarding the outer range between the Sárda and the Brahmaputra. There is this peculiarity in Kumaon, that the outer range first crossed by the traveller is of considerably higher elevation than the intermediate ranges crossed between it and the outlying spurs of the great snowy range itself. We have said that we hold the entire Himálaya to be but the southern slope of the great Tibetan plateau; that however rugged and furrowed this slope appears, it is homogeneous throughout. We reserve for the district notices the purely geographical description, and will here try to answer the questions that naturally arise regarding these mountains as a whole. What have geologists been able to discover regarding their history and the materials of which they are composed, and are the causes at work sufficient to produce such very varied results as are here exhibited? In attempting[1] to answer these questions, we must refer to well-known principles,[2] which have been found true in Europe and apply with equal or even greater force to the phenomena observable in the Himálaya. Without trespassing on the domain of the professed geologist, we may briefly summarise the facts observed regarding the Himálaya as a whole. We have seen that the outer range forms a geological as well as a physical boundary under Kumaon. The *whole mountain mass may be divided into three great belts.* First, the sub-Himálayan tertiary sandstones outside the Himálaya proper of geologists, and which have a considerable development west of the Jumna. To them belong the Siwáliks and the Sirmúr series on which the hill sanitaria of Kasauli, Dagshái, and Subáthu are built. Secondly, a belt of limestone and slate forming the outer range of the lower Himálaya on which the hill sanitaria of Simla, Chakráta, Masúri, Landaur, and Naini Tál are situate. Thirdly, the crystalline rocks with granitic intrusions that form the remainder of the lower Himálayan region as well as the line of snowy peaks, and across the British frontier to the north of Kumaon, the paleozoic and secondary rocks of Tibet. Thus we have as the materials of the Himálaya the two great classes of rock known as the stratified or bedded and the crystalline. To the former belong the limestone, sandstones, and slates that have been derived from the waste of the older rocks ; and to the latter the granite, gneiss, and schists which occur in masses.

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[1] Manual of Geology, p. 543.

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[1] My acknowledgements are due to the works of Medlicott, Blandford, Tyndall, and Geikie, on which the following pages are based.

[2] Though known to every student, a re-statement of these principles seems necessary in a work intended for popular use in India

Materials of the Himálaya.

The core or nucleus of all great mountain masses is formed of crystalline rocks, while the stratified rocks enter largely into the composition of the lower subordinate ranges. This is true of the Himálaya, Alps, Pyrenees, Rocky Mountains, and indeed of all the great mountain systems. A glance at the geological map given hereafter will show more clearly than any description the arrangement of these rocks in Kumaon. One of the fundamental principles of geology is that the sites of all the great mountain masses of the world at one time formed a part of the bottom of the sea. K2, Nanda Devi and Mount Everest, the last of which exceeds a height of 29,000 feet above the level of the sea, at one time apparently formed parts of the bed of an ancient ocean. For the crystalline rocks have arisen either from the gradual consolidation of materials which had been fused deep within the crust of the earth or from the influence of subterranean water combined with the earth's internal heat, out of earlier sediments such as sea-mud and sea-sand, which in the course of time had sunk down and been covered by many thousands of feet of later deposits.[1] Geologists tell us[2] that while no important movements, except small and partial changes of elevation, can be traced in the peninsular formations of India, the whole of the gigantic forces, to which the contortion and folding of the Himálaya and the other extra-peninsular mountains are due, must have been exercised since eocene times. The sub-Himálayan beds were deposited upon uncontorted palæozoic rocks ; and although a part of the Himálayan area may have then been land, the direction of the ranges is clearly due to post-eocene disturbance. It has also been shown that the movement has been distributed over the tertiary, post-tertiary, and pleistocene periods. It has been suggested that upheaval still goes[1] on, as earthquakes are of common occurrence along the line of the Himálaya and as far westwards as Kábul. Three distinct shocks were felt at Naini Tál in April, 1880, and Srinagar in Garhwál was almost destroyed by a great earthquake in 1803. A recent traveller,

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[1] Professor Geikie on 'Mountain architecture.' [2] Manual of the Geology of India, *loc.*

M. Severtsof, attributes the contraction of the great Kára-kul lake on the western Pámír to a similar cause, and says that the connection of the Tián-shán with the Pámír is due to an upheaval which geologically is of recent date and is still progressing. At the end of the cretaceous period and at the beginning of the tertiary period, the Tián-shán was separated from the Pámír by a strait with rocky islands, the marine deposits of which are found beyond the Tuz-Ashu pass. It is startling to the uninitiated to be told that the mighty mass of the Himálaya, as it now appears, is a formation younger than the comparatively insignificant hills of the Dakhin (Deccan) and Central India. The same, however, is said of the Alps, Pyrenees, Andes, and Rocky Mountains, all of which received their chief upheaval in tertiary times.

Eocene period.

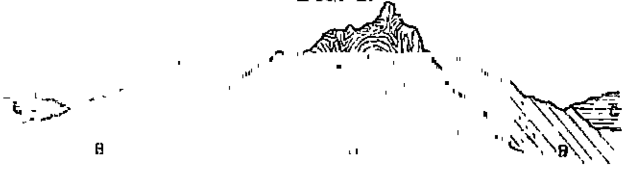
According to Mr. Blandford it is probable that the crystalline axis of the western Himálaya which apparently terminates in the Dhauladhár peak, the western extremity of the snowy range seen from Simla, coincides with the shore of the ancient paleozoic continent of which the Indian peninsula formed a portion. If this be a correct view, the cis-Himálayan paleozoic rocks are in a great part of fresh water origin, whilst the marine paleozoic formations are found throughout the extreme north of the Panjáb, Kashmír, and the neighbouring countries north of the Dhauladhár and crystalline axis. In eocene times, the peninsula of India was part of a great continent probably united with Africa. To the east was a great sea extending up the Asám valley along the southern base of the Gáro hills and thence southward throughout a considerable area west of the Irawadi in Barma. There was another sea to the north-west covering a great part, if not the whole, of Persia, Baluchistán, the Indus plain, and extending as far north-east as Garhwál, and an arm of this sea extended up the Indus valley into Ladák. The Himálaya and perhaps Tibet, wholly or in part, were raised above the sea, but there is no evidence to show that they had then attained any unusual elevation. In later eocene times, the Himálaya had risen sufficiently to send back the sea boundary to the north of the Panjáb, and in miocene times, the marine area was still further contracted. The existence of a sea in these places is attested by the presence of marine deposits and shells, and this discovery clearly shows that not only did the sites in which they occur once form the bottom of a sea but that the difference in height now observed between them and the level of the sea must be greatly added to in order to arrive at the true measure of the upheaval that has since occurred. The work of denudation that continually goes on shows us that the present summits of the mountains must in the course of time have lost a considerable portion of their substance, and in the next place we cannot suppose that the marine shells now found lay exactly at the sea level. The bed of the great sea may also have been subject to successive periods of depression and elevation before the eocene period without greatly altering its height. Professor Geikie[1] tells us what the forces are to which these marvellous results are due:—"The upheaval of the sea floor into land seems to have been due to a cause which has been going on from the earliest geological times and which is still in progress. It is believed that originally this planet possessed an enormously high temperature; that, indeed, it was thrown off from its parent sun with a temperature probably even much fiercer than that of the sun at present; and that it has since been gradually cooling and contracting. The external crust of the earth, varying greatly in structure and otherwise, has yielded unequally to the strain of contraction. One result of this process has been the elevation of portions here and there into long ridges, forming the continental masses and mountain chains. You may illustrate this production of lines of elevation along a generally subsiding surface by what takes place when an apple dries. Its surface contracts and wrinkles, most of the skin sinking inwards, but, at the same time, inequally and leaving intermediate ridges to stand up. So in the gradual contraction of our planet, wrinkles have arisen on its surface. It is these wrinkles which form our mountain chains. But such a subsidence of the crust could not have taken place without a very great deal of folding of the rocks. Descending nearer to the earth's centre, the various layers of the crust had a less diameter to fill. They could only accommodate themselves to their new position by being crumpled up so as to occupy less space, or by being cracked across so as to allow some parts to be pushed above others." We find that both these results have been produced, and the records of the Indian Geological Survey teem with illustrations of them.

[1] *l. c.*

Mode of mountain formation.

One other fact is noticed, by the same writer, in connection with the crumpling up of the mountains, and that is that this process has been the means of bringing up the crystalline rocks. "Before the time of the crumpling, the whole future mountain area was covered with one continuous sheet of marine strata. But as the mountain chain began to form, the central portions came to be more and more compressed, puckered, and crystalline, some parts being squeezed up, whilst intrusive masses and veins of granite and other crystalline rocks were injected amongst the intensely altered strata along the central nucleus or core. It was during this process, doubtless, that the crystallisation of the gneisses and schists took place, when they passed from their original character of fragmentary (bedded) rocks and assumed the peculiar crystalline texture which they now present." We have already noticed that there have been successive upheavals of the Himálayan mass through the tertiary and post-tertiary and even the pleistocene periods, and the effect of these upheavals on the form of the mountain ranges must have been considerable. Supposing, with Professor Geikie, that a whole mass of sedimentary rocks has been upheaved into land as a mountain chain, we find that "on the outskirts of this elevated area, sedimentary deposits will continue to accumulate in the sea. If in the course of the slow secular contraction of the planet the upraised tract subsides, a new set of strata will be laid down upon the upturned edges of the older rocks. It is evident that in every junction of this kind, some considerable interval must have elapsed between the formation of the older series of rocks A (Fig. 4.) and the newer series B.

FIG. 4.



Section of a mountain chain showing three epochs of upheaval (Geikie).

"In the course of time, the region having once yielded to the strain from terrestrial contraction will probably yield again, and a new upheaval will take place. The series B will now be raised up together with A, and another series C will be laid down in turn upon its edges. Subsequently, the same fate will befall the group C. These three sets of differently inclined strata would fix for us three successive periods of upheaval." This simple explanation shows how very varying must be the results of successive periods of depression and upheaval, and especially when, as in the case of the Himálaya, such an immense area has been subject to disturbance. We have now seen that the primary factor in mountain architecture are the great changes in the earth's crust by which mountains have been formed, and the bedded deposits have become rocks, and eventually, as the process of upheaval went on, have been crumpled, folded, crystallised, and fractured. In this process, lateral pressure has been the chief agent, and this has been exerted simultaneously from different sides in the case of the Himálaya, at least in the pleistocene period. No better examples can be given than those enumerated by Mr. Blandford as characteristic of the western area. Here we have amongst the mountain ridges that encircle the Indus plain and comprise pliocene beds, "ranges running north and south such as the Khirthar and Sulaimán; east and west as the Mari and Bhugti and the Afrídi hills; north-west and south-east as the Pir Panjál; north-east and south-west as the eastern Salt Range and Kharian hills; and many intermediate directions may also be traced, independently of curved ridges." Of the extent of these lateral thrusts an example will be found to the west of the Indus. Taking the Persian area and that of the Himálaya and Tibet, "the mountain ranges fall roughly into two great curves convex to the southward; but the deeper western curve has produced the smaller mountain ranges. That a gigantic lateral movement has taken place in the apex of the western curve is, however, shown by the fact that for nearly 150 miles between Gwádar and Jálk in Baluchistán, the track traverses beds, all apparently of tertiary age, at right angles to their strike and that all these beds are vertical or nearly so. The contraction in breadth, or in other words, the lateral movement must have been great to have converted horizontal formations into a series of undulations, with dips so high as those seen in the Baluchistán ranges." The terms at our disposal to denote the relations of magnitude and adequately to depict the changes that have been wrought during such a period are utterly insufficient to convey a correct idea of what has taken place. Perhaps

Professor Geikie's simile of the dried apple is as far as we can go without entering into scientific details that belong to the professed geologist.

Mountain sculpture.

Ice-wedges.

Only second in importance to subterranean influence in the formation of mountains are the sub-aërial tools of the great sculptor, the different forms of water, ice-wedges, glaciers, snow, rain, and rivers.[1] It is impossible to say what may have been the appearance of the mountain ranges when first formed, but we have every reason to believe that usually the process was gradual and that at once the denuding influence of the different forms of water came into play. Nature from the time the first atmosphere existed has ever been at work tracing lines which gradually work into gorges, ravines, and valleys, weathering peaks and rounding ridges and producing those alterations in the general appearance of the mountains that on a very small scale are familiar to most of us in a neglected hill-station. Both crystalline and bedded rocks abound in joints or divisional planes by which they are separable into blocks and no small part of nature's work in sculpturing mountains is thus rendered possible. Into these crevices runs the melted snow or rain, and there congeals and again expands, forcing the blocks asunder by slow degrees. The sun's rays turn the ice into water during the day, to penetrate still further and again congeal during the night, and this ceaseless process continued for many centuries shows its effect in the form of the mountains composed of even the hardest rocks. These are covered with massive boulders quarried by nature's ice-wedges in this simple fashion. Where the dislocation takes place near the edge of a weathered cliff, the mass of ruin caused by the toppling over of huge blocks is often gigantic. Gerard describes the upper portion of Purgial (Lío Porgyúl) as the "wreck of some towering peak burst asunder by severe frost." Fraser tells us that the summits near Gangotri and Jamnotri are a mere confused mass of huge crumbling boulders, and the same description applies to nearly all the peaks that have been visited by travellers.

Avalanches.

We have next to notice snow in the form of avalanches as one *of the tools employed in mountain sculpture.* The winter snow, when exposed to the summer sun and influenced also by the heat of the earth itself, is often detached in masses sufficient to cause great natural disturbances. It has been suggested that the change in the bed of the Satlaj in the plains to its present one has been produced by an avalanche in its upper course having dammed up the river. In time the barrier gave way and sent down an immense flood to the plains, sufficient to carve out a more direct course which the river itself has since continued to occupy.

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[1] Acknowledgment is due here to Professor Tyndall's and Professor A. Geikie's mountain architecture

Glaciers.

It is, however, to the action of snow in the form of glaciers that the more important results are due. These great engines of denudation have the form of a solid river ever progressing downwards through the valleys until the point is reached where the rate of motion is balanced by the melting of the ice. In the figure of the Pindari glacier, given hereafter, it will be seen that the glacier fills the bed of the upper valley and is fed by the drainage of the snow-covered slopes on either side. Its face is discoloured with mud and stones and is utterly unlike one's preconceived idea of masses of ice. Along the sides and edges, too, are rows of earth, stones, and boulders transported and deposited in order by the ice-stream. These deposits are called moraines. Much of the material transported falls down into the crevices and gets between the bottom of the glacier and the rocky bed along which it moves, and which is thus subjected to a grinding process that reduces even the hardest rocks to powder. This fact accounts for the turbid character of glacier streams, especially near their source. The influence of glaciers, therefore, is two-fold, firstly in transporting materials and secondly in reducing them to mud or sand. The combined result is often seen in the mass of detritus heaped up towards the end of a glacier called a terminal moraine, and in the striated and smoothed appearance of the rocks that have been subjected to glacial action. As will be seen hereafter, there is sufficient evidence of a great extension of glacial action in former times that must have had a very important influence on the form of the mountains. Cunningham records three great inundations of the Indus due to the bursting of glaciers in the upper portions of its course. These had dammed up the river bed and eventually gave way, sending a flood down the channel which in the cataclysm of June, 1841, appeared as a wall of water some thirty feet high, destroying every thing that came within its reach.[1]

Rain

Rain has had even a more constant and penetrating influence on the mountain masses than any of the preceding forms, for it has furnished the materials from which the ice has been formed and is more universal in its operations. The salts and acids contained in it have also had a peculiar action of their own. Rain while falling through the air takes up some portion of carbonic acid and when it reaches a rock dissolves and carries away certain portions of its texture. The result of this process is that not only is the rock reduced in bulk by chemical action but what remains also becomes more easily operated on by the mechanical action of falling water in the next shower. For illustrations of these processes take any line along the limestone ridges about the hill sanitaria already mentioned, and it will be seen how the outer crust where exposed is crumbly to the touch, and has a rough sandy appearance. For those who have seen the long gneissic range extending from Almora to Devi Dhura in Kumaon, there could not be a better example of the influence of rain on rock than is there exhibited. Along the road on each side where the rock has been exposed to the weather, the outer layer is removable by the hand, and at the base will be found a little heap of sand that has been weathered away in course of time. Many of the more loosely formed shales, especially those that contain alum, speedily decompose on exposure to the atmosphere and it is on this account that in the midst of rocky formations in the Himálaya it is so often very difficult to obtain good building stone. Another familiar example of the influence of the rain-fall on the rocks will be seen in the stones of old buildings throughout the hills. Where protected from the weather their surface exhibits the faintest trace of the graver's tool intact, but where exposed they are worn and eaten into and the outer skin appears granulated and rough. This waste of rock material has been in progress for centuries and has produced a soil in which trees have taken root and shed their leaves to produce by decomposition and mixture with the waste the rich vegetable mould that overlies our forest-clad hills. The presence of these trees has had the further effect of retarding the removal of the newly formed soil not only by absorbing a portion of the chemical elements carried down by the rain-water, but also by breaking the force with which the rain would otherwise fall on the soft soil. Thus we find that on well wooded hills the depth of useful soil is considerable and that springs are numerous and abundant. On the other hand where the hills have been cleared of forests, the finer soils are soon washed away by the almost tropical rain. The rocks from which the soil has been formed again appear at the surface and the rainfall rapidly drains off leaving no supply for springs, and if the process be continued over any considerable area, cultivation becomes impossible and the climate is essentially altered. What deforesting has done for Almora can be seen in its scanty rain-fall, its barren slopes, and few springs, although the area affected is so small.

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[1] Ladak, 104 : J. A. S. Ben. X, 617 : XII, 183 · XVII, 230

Rivers.

The action of a river in the sculpture of mountains is three-fold. First, it has the chemical action of rain in dissolving portions of rock constituents: again, it has in its mountain course the grinding power of the glacier in the force with which it drives the gravel, stones, and boulders along its rocky bed: and thirdly, it has the glacier function of transporting material and laying them down in deposits elsewhere. In the case of glaciers the denuding process is the more important, and in the case of rivers the transporting function has, perhaps, more influence in moulding the features of the surrounding country. In the beds of many of our mountain streams we can detect the action of both glaciers and rivers in the striated and furrowed appearances produced by the former and the rounded forms of worn pebbles due to the influence of flowing water. The muddy colour of the water is due to mud or sand held in suspension, and it has been estimated that in this way one six-thousandth part of a foot is annually carried away from the water-shed of a great river. This waste is, however, very unequally distributed, being very much greater in slopes and valleys and less in plains. "We may be prepared, therefore," with Professor Geikie, "to find that solely by the continued erosion of running water, even the most recently upheaved mountain chains have had stupendous chasms carved out of their sides, and an almost incredible amount of material removed from their surface." Such has been the origin of the Scottish valleys which, according to the same writer, " have been cut out of the general mass of the upraised rock. The existing mountains are what we now find them to be, because they have been left standing while the valleys have been excavated among them." Playfair in his "Illustrations of the Huttonian Theory," as quoted by the same author, writes :—"If indeed a river consisted of a single stream without branches, running in a straight valley, it might be supposed that some great concussion, or some powerful torrent, had opened at once the channel by which its waters are conducted to the ocean; but when the usual form of a river is considered, the trunk divided into many branches, and then again subdivided into an infinity of smaller ramifications, it becomes strongly impressed upon the mind that all these channels have been cut by the waters themselves ; that they have been slowly dug out by the washing and erosion of the land; and that it is by the repeated touches of the same instrument that this curious assemblage of lines has been engraved so deeply on the surface of the globe." In major and minor river systems the same principle is observed ; the lines marking the tributaries of a stream appear like the veins of a leaf all converging on the mid-rib and each forming within its own area a separate main line of a smaller system until the differences are inappreciable. But it may be asked why, if these influences are uniform in their action, the results are so varied. The answer is not far to seek and is to be found in the varied character of the materials on which the aërial forces operate. The southern flank of the Siwáliks below Dehra, consisting of soft sandstones, are weathered by the heavy monsoon rains until they are almost perpendicular. The Krol limestones give their picturesque outline to the outer Himálaya, when compared with the other lower ranges. The shales and slates have a character of their own, and the great crystalline range itself owes its form to the rocks of which it is composed. Kamet has its peculiar pyramidal shape from its cap of granite, and Nanda Devi, Trisúl, and the Panch Chúli have had their peaks defined by simple aërial action on their materials. Thus, our mountain ranges are due in the first place to subterranean disturbances, and in the second place, to the action of the different forms of water, chemically and mechanically, on the varied materials of which the rocks are composed. It is the combination of these two forces that gives such varied results, and until more accurate and comprehensive information is recorded regarding their operation, it is impossible to base our physical description on other than arbitrary grounds.

CHAPTER III.

GEOLOGY.[1]

CONTENTS.

Position of the ground. Early observers: Herbert, Cantley, Falconer. The mountain system. The sub-Himálayan zone formed of tertiary rocks Siwáliks. Post-tertiary deposits. Supposed glacial deposits Lower Himálayan region. Simla region. Sirmúr formation. Relation of Sirmúr and Siwálik series. The Satlaj valley. East of Simla. The Kumaon section. The Nepál section. Sikkim section. Slight correspondence between the rocks of the Himálaya and of the Peninsula. Frequent occurrence of carbonaceous deposits throughout the Lower Himálaya. Conjectural affiliation of the Lower Himálayan sections The Central Himálaya. Strachey. Stoliczka. Western Tibet. The principal crystalline areas. Nummulitic deposits. Post-eocene eruptive rocks. Central gneiss Kashmír-Kishtwár region. Central Tibet. Its granites, schists, slates, conglomerates and fossiliferous rocks. Palæozoic strata, Silurian, Trias, Jurassic. Fossils. Tertiary deposits So-called Níti fossils. General Strachey's conclusions Stoliczka's views.

Position of the ground.

THE British Himálayan districts, which form the immediate subject of this sketch, are themselves such a small portion of the immense geological region to which they belong, that we shall have to wander considerably beyond their limits to attain some idea of their place in nature. Some of the ground forms part of one of the best known, and certainly the most widely known, of our Indian rock-formations: the Dehra Dún is pre-eminently the Dún; and the low hills separating it from the wide Gangetic plains are the original Siwáliks, a name to be found in every geological text book. The rocks of the higher hills to the north, below the snowy range, have as yet received only cursory attention, being chiefly non-fossiliferous slates and crystalline schists. On the snowy range and beyond it in Chinese territory we again come upon formations of well-established position, but of which we have little real knowledge, and are altogether dependent upon the occasional observations of a few adventurous explorers.

Early observers.

In geology, no less than in other sciences, it is desirable to be able to trace the stages of knowledge. Even in descriptive geology this information is interesting; and for the student such illustrations are almost essential. Although the germinal idea of geology, that the aboriginal superposition of sedimentary deposits is a sure indication of succession in time of formation, and hence that the structural relations of rocks are the ultimate criterion of age, had to be conceived before geology could have birth. The difficulty of applying this test, of observing obscure and scattered outcrops, and of putting together and discussing the features thus laboriously collected, is so great, that, from the beginning, geologists have sought for, and adopted more ready tests for the chronological classification of rocks. The history of progress in geology is in great measure made up of the failures of generalisations thus too hastily arrived at; the total breakdown of false assumptions, and the correction of errors due to the forced application of partially understood principles; to the neglect of the regulating laws of structure. The science is so young that its history in India affords examples of these errors. In some cases our admiration of the men and the work they accomplished is positively enhanced by our knowledge of the difficulties under which they laboured. The names Herbert, Falconer, Cautley, and Strachey call especially for mention in connection with the ground under notice. Cautley and Falconer will be imperishably associated with the palæontological branch of geology, as having with great labour brought together the unrivalled collection of fossils, the description of which was partially published in the Fauna Antiqua Sivalensis. Work of this kind endures, in so far as it is to a great extent a record of hard facts, having each a permanent interest, such as the existence of a certain fossil within a fixed range of strata. It is not so with facts of the first order in geology proper: the announcement that such a kind of stone occurs in any particular place conveys no information that can be said to have scientific value; it is only when accumulated and colligated under established principles of formation that such petrographical facts come to have any geological meaning. Herbert's observations were of this order. He dealt entirely with unfossiliferous rocks, and the principles under which he had to arrange those observations were still to a great extent artificial; his work has therefore only an historical interest.

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[1] This chapter has been written by Mr. H. B. Medlicott, Superintendent of the Geological Survey of India, for this volume.—E. T. A.

Herbert.

Captain G. D. Herbert, however, must rank in merit as well as by date amongst the foremost pioneers of geology in India. As a man of great talent and of sound and extensive scientific culture, he may stand with Captain

Newbold, who did so much for the geology of Southern India. The advantage of the latter lay in the greater simplicity of the ground he worked in and in his being even a few years later in the field. The mineralogical survey of the Himálayan districts was one of the earliest attempts at a geological map of a considerable area made officially in India. The work was entrusted to Captain Herbert by the Marquis of Hastings; but it was left to private enterprise to make known the results. The publication was taken up by Mr. Henry Torrens, of the Bengal Civil Service, the accomplished editor and proprietor of the so-called Journal of the Asiatic Society of Bengal, which was then brought out at the personal risk and responsibility of the Society's Secretary, and was really the continuation of the publication started by Captain Herbert himself in 1829 with the more appropriate title (under such conditions) of Gleanings in Science. The report appeared as an extra number of volume XI. of the Journal for 1842, nine years after the death of Captain Herbert, and seventeen years after the completion of the survey. The map to illustrate the report was issued with volume XIII. for 1844. It comprises the very large area lying between the river Káli and Satlaj, more than 200 miles in length, and from the plains to beyond the snowy peaks, a breadth of 90 miles. Captain Herbert does not assume any pretensions to authority. He tells us very plainly that he made up his geology for the occasion, but it is plain, too, from his observations and reflections, that he thoroughly mastered his authors. His suggestions in correction of current views are often very judicious, and display a truly scientific turn of mind. His work, nevertheless, can only be noticed in illustration of the history of Indian geology. He divides all the rocks of the mountains into two great 'primary' formations—one for the gneiss occupying the central region, and one for the micaceous, chloritic, hornblendic, and argillaceous schists, to which also he joins the limestones. He makes a third zone of the narrow strip of "secondary rocks, mostly, if not entirely, the Newer Red, or Saliferous Sandstone." On the strength of this purely imaginary identification borings were recommended, if not actually undertaken, along the margin of the plains, to find the carboniferous formation with its coal. This notion was not quite exploded by the discovery of the famous tertiary fauna in a part of the rocks designated by Herbert as New Red Sandstone;

His geological theories.

and by the latest writers, prior to the Geological Survey, the sandstone along the fringe of the Kumaon mountains, and now known as the Náhan or lower Siwálik group, are treated as secondary. The constant dip of the rocks of the southern Himálaya towards the central axis, so marked a feature in their structure, was treated by Herbert in a manner characteristic of the times. His three formations being by assumption successive in order of time, the observed structure seemed to subvert this ordained relation, making the younger apparently pass beneath the older, the schists beneath the gneiss, and the sandstones beneath the schists. He attempted first to explain this anomalous feature by faulting; but when his calculations seemed to demand a fault having a throw of eight miles, he gave up the idea in favour of a supposition infinitely more extravagant. He came to the conclusion that the apparent bedding in each of his three series is not true stratification, due to the process of deposition in water, but only pseudo-stratification, produced by some process of concretionary action; thus, for the sake of a collateral issue, he cut away the very foundations of the science of geology.

Cautley and Falconer.

The work of Cautley and Falconer was the geological converse of that attempted by Herbert. They dealt entirely with one series of rocks, and treated them almost exclusively from the point of view of their fossil contents. The range of their operations was limited to the low fringing hills between the Ganges and the Satlaj. The structural features were very slightly touched upon, the strata being taken to belong to one unbroken formation, which was recognised as of geologically recent date, and as being distinctly made up of the débris of the Himálaya. The following abstract list of fossils will give an idea of the extent of their labours, and of the richness of the fauna they discovered :—

SIWALIK FOSSIL VERTEBRATES.

QUADRUMANA.

Semnopithecus, Pithecus.

CARNIVORA.

Hyæna, Amphicyon, Hyænarctos, Canis Mellivora, Felis, Drepanodon, Lutra, Enhydriodon.

PROBOSCIDIA.

Stegodon (4 sp.), *Loxodon* (1 sp.), *Euelephas*, *Mastodon* (2 sp.), *Dinotherium* (sp.).

ARTIODACTYLA.

Hexaprotodon, *Merycopotamus*, *Hippohyus*, *Sus*, *Chalicotherium*, *Sivatherium*, *Antilope*, *Cervus* (sp.), *Camelopardalis*, *Camelus*, *Bos* (sp.), *Hemibos*, *Amphibos*.

PERISSODACTYLA.

Rhinoceros (3 sp.), *Antoletherium*, *Equus*, *Hippotherium*.

REPTILIA.

Crocodilus, *Leptorhynchus*, *Varanus*, *Colossochelys*, *Emys*, *Trionyx*, *Testudo*.

Undetermined species of *Aves*, *Pisces*, *Mollusca* and *Crustacea*.

Strachey.

It is to Captain Richard Strachey, of the Bengal Engineers, now General Strachey, Member of the India Council, that we owe the first sound attempt at a sketch of Himálayan geology based upon extensive observation. An abstract of his results was published in the Quarterly Journal of the Geological Society of London for November, 1851, and the map accompanying his paper includes about the same ground as that of Herbert. A comparison of the two maps shows how great an advance had been made. It is greatly to be regretted that official and other business prevents General Strachey from making with his own hand the few corrections and additions necessary to bring his work up to date for the present publication. The annexed map is little more than a reproduction of General Strachey's, and the description also of a large portion of the ground is a reprint of his paper.[1] Acknowledgment is made by him that a considerable portion of the observations recorded were contributed by his brother, now Sir John Strachey, late Lieutenant-Governor of these provinces.

The mountain system.

For the geographer a mountain chain is fixed by the conditions of continuity and direction. The geologist would fain make his mountain systems to depend primarily upon contemporaneity of formation, as suggesting causal connection. From neither point of view can the Himálaya pretend to fixity of limits. On the south, indeed, no great physical boundary could be more marked than the base of the mountains between the Jhelum on the west and the Bramaputra on the east, a distance of about 1,500 miles. The line is remarkably unbroken, without projecting spurs or open re-entering valleys. It has a uniform curve, the bearing in Upper Asám being to east by north, while in the Panjáb it is nearly to north-west. Throughout this entire length the hills rise abruptly from the alluvial plains. The terminations of this boundary are also very well marked. The Asám valley ends against the ranges of the Barma-Malayan mountains, which pass up from the south, at right angles to the Himálayan chain, to coalesce with it in the elevated regions of Eastern Tibet. Similarly on the north-west the ranges of the Sulimán and Hindu Kush pass continuously into the mountain region of Little Tibet, nearly at right angles to the run of the north-west Himálaya. It is on the north that the question of a physical boundary is to a great extent arbitrary. The chain of mountains that, under the name of Himálaya, forms the northern boundary of Hindustan, is in reality the southern face of the great mass of elevated land extending through nearly 30 degrees of longitude, from the sources of the Oxus to those of the great rivers of China, while its northern face appears upon our maps as the range called Kuenluen. To the south lie the plains of India, whose greatest elevation is about 1,000 feet above the sea; while on the north is the Central Asiatic desert, which nowhere is at a less altitude than 3,000 feet. The loftiest summits known on the surface of the earth are to be found towards the southern edge of this elevated region, at least one peak having been measured whose height is upwards of 29,000 feet, while along the whole line peaks of 20,000 feet abound.

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[1] On the Geology of Part of the Himálaya Mountains and Tibet: Quar. Jour., Geol. Soc., London, 1st November, 1851, Vol. VII.—E. T. A.

Tibetan plateau.

So little is known of the interior and northern parts of this region that it is impossible to offer any general account of it based upon actual observation; but as far as we may judge from those parts that have been explored, it appears that the surface is, with few exceptions, broken up into a mass of mountains, the general elevation of which, valleys as well as ridges, is very great; and there seems no reason for supposing that either the Himálayan or Kuenluen have any definite special existence as mountain ranges apart from the general elevated mass of which they appear to be the two opposite faces. The portion of the southern chain to which the following description more particularly refers, is somewhat to the west of a central line, on about the 80th degree of east longitude, which meridian passes through the island of Ceylon, and not far from Cape Comorin. The order of notice will be in successive zones from south to north—the plains, the Sub-Himálayan zone, the Outer or Lower Himálaya, and the Central Himálaya.

The plains.

While difference of opinion exists as to the formation of the most recent deposits, it is not to be wondered at that there is often much doubt as to the origin of ancient formations. The primitive idea that a water-basin is necessary to the accumulation of extensive sedimentary deposits is still widely held. To it is primarily due the not yet obsolete opinion that the plains of India are in great part of marine origin. The only direct evidence in support of this view is the local occurrence of salt-wells, which also involves a popular error, for although the sea is the great receptacle of salt, it is chiefly by rock-decomposition on dry land that salts originate. This fact is likely to force itself disagreeably upon future generations in India ; at present we have only to do with it as at least weakening a mistaken geological position. The only fossil remains found in these plains-deposits are of land or fresh water origin, and these occur even in the delta below the present sea level.

Bhábar.

Tarái.

The surface-form, and the distribution of the materials of these deposits, is, moreover, just what is now understood to be due to the normal action of rivers above their final point of discharge. Torrents, streams and rain-scour from the precipitous slopes have accumulated a wide bank of coarse diluvial deposits along the base of the mountains which is known in these provinces as the *bhábar* or forest zone. In Rohilkhand it is about ten miles wide, and has a fall of from fifty to seventeen feet per mile, and, except in the rainy season, water is not procurable in it. Even considerable streams sink into the porous gravel-beds. Outside the *bhábar* is the *tarái*, also about ten miles wide, in which water is superabundant, producing swamps and excessive moisture. Formerly it was supposed that this was an area of actual depression; it has, however, a very considerable fall, averaging (in Rohilkhand) more than ten feet in a mile. The moisture is due to the copious re-appearance of the water absorbed at the head of the *bhábar*. From the *taráí* the plains gradually decrease in slope to three or four inches per mile in the deltaic regions.

The Sub-Himálayan or Siwálik zone, formed of tertiary rocks.

A belt of fringing ridges, varying in width and abruptly lower than the contiguous mass of the Himálaya, occurs throughout their entire length, with perhaps two short interruptions in Lower Asám, which are doubtfully and in part attributed to denudation. The pure geographer might, in some places, ignore this feature, as perhaps below Naini Tál and Darjeeling, choosing to regard its representative there as mere spurs of the mountains. Geological observation, however, draws attention to geographical features that might otherwise escape notice, and notes that these so-called spurs will always be found affecting the form, not of spurs proper, but of ridges parallel to the adjoining mountains, and in a more or less marked degree semi-detached from them by a chain of deep longitudinal gorges and low gaps, corresponding with a leading geological boundary, that between the old slaty and schistose rocks of the mountains and the massive tertiary sandstones of these fringing hills.

Divisions of the tertiary series

From this double consideration the name Sub-Himálaya has been given to these lower ranges and to the rock-series forming them. For the most part these hills are apparent to the least observant traveller, their outer ranges being separated from the inner ones by broad flat valleys, or *dúns*. These more detached ridges have long been familiarly called Siwáliks, a name extended by Cautley from the native name (Shib-wala) of the representative range separating the Dehra Dún from the plains. This name, too, has been hitherto currently applied to the hills and rocks here described as Sub-Himálayan, wherever distinctly recognised. The closer study of this zone has, however, brought to light distinctions involving some difficulties regarding the application of this familiar name. It has been found that there are recognisable divisions in this great series of the tertiary deposits of the Sub-Himálayan hills, and that the younger of these groups contains by far the largest share (if not all) of the well known Siwálik fossils. On this account it was proposed to restrict the name Siwálik to the band in which those fossils occur: but there are good reasons for preferring to continue the extension of the old name, and to indicate the separable geological horizons as Upper, Middle, and Lower Siwáliks. On the small map annexed they are coloured together as upper tertiary.

Supposed key section of unconformable groups.

It was in the ground west of the Jumna, between the Kayarda and Pinjor dúns, where the outer and inner hills are confluent for a length of about forty miles, that the separation of the original Siwálik series into distinct groups was first brought to notice. Throughout the whole cross-section the dip of the strata is inwards, towards the mountains; but along a sharply marked line, continuous through the length of these hills, there is a junction of highly contrasting rocks: the brown and yellow clays, and conglomeratic gravels at the top of the series forming the outer zones of low hills, abut against harder red clays and sandstones forming an inner zone of somewhat higher hills. The feature is nowhere better seen than in the region of the Márkanda, south of the town of Náhan, the capital of Sirmúr. As is generally the case along the junction of rocks of very different textures, the actual surface of contact is concealed by débris; and the appearance suggested by the conformable dips is that the outer rocks pass regularly beneath the inner ones.

Overlooked by early observers.

Such was the view tacitly adopted by the discoverers of the *Fauna Sivalensis*. It was from the same trans-Jumna region, south of Náhan and of this rock-junction, that a very large proportion of the great Siwálik fossils were procured. No particular notice was taken of the striking feature just described; and Cautley accounted for the absence to the east of the Jumna of the highly fossiliferous beds known to the west, by supposing a lesser upheavement of the ground to have occurred in that direction; thus distinctly implying that those beds underlie and are older than the rocks of the cis-Jumna Siwálik range, which he had himself, from fossil and petrological evidence, identified with the rocks at Náhan.

Nature of the unconformity

Herbert's deliberate rejection of the elementary fact of stratification, to make way for a theoretical difficulty, is scarcely a less remarkable datemark than the ignoring of so striking a stratigraphical feature by the original explorers of the Siwáliks. The facies of the two contrasting groups, as seen along the boundary, at once suggest that the outer and apparently underlying rocks are really the younger, and this is immediately confirmed by finding that the conglomerates of this group are principally made up of the débris of the contiguous inner strata. Although this latter fact would be somewhat against the supposition, the steep abutting rock-junction would next suggest a fault, along which the lower strata were upheaved on the north, and thus brought into contact with younger beds of the same series. Patient search, however, revealed an exposed section of the actual contact showing the relation of the strata to be quite different from that implied by faulting. The conglomerates were found to rest against a denuded surface of the older group of rocks; the junction being in fact that of an original steep edge of deposition to which an actually overhanging, inverted pitch had been given at many points by subsequent lateral compression.

First inferences from it.

The feature, as thus described, involves much more than simple successive deposition of the groups. It exhibits strong unconformity between them, requiring the older group to have been upraised and deeply denuded before and during the formation of the younger one. Such a relation generally implies a considerable break and lapse of time between the formations, with a corresponding change in their fossil fauna. It is precisely the history of such changes which it is the business of geology to unfold. But to the unfortunate neglect of the simplest stratigraphical observations, fossils from both groups were mixed together in the magnificent collection that lay ready to the hand of the early discoverers. On account of the character and extent of this stratigraphical feature, suggesting that an unconformity of such depth must have a very wide range, it was proposed by the first observer of it to restrict the name Siwálik to the younger formation, and to designate the older rocks, of the inner zone, as the Náhan group. It is the name by which Cautley identified a certain horizon in the series, although apparently assigning to it a position the reverse of the correct one.

Corrected view.

Large as is the gap absolutely required between the ages of the beds actually in contact along this boundary, it was matter of surprise from the first that no trace of so great an unconformity could be found in the immense thickness of deposits to the south of it. From the conglomerates at the junction, southwards to the plains, one crosses a descending section of several thousands of feet of strata without a trace of unconformity: showing either that even at the base of this section the beds of the Náhan group are not represented, or that the disturbance which produced the unconformity along this line of abrupt contact was of such a nature as to admit of continuous deposition within so very short a distance. Ruling ideas at the time were certainly against the latter supposition, that extended observation seems to confirm it. Going westwards along the Pinjor Dún, we find at the Satlaj, on the very strike and extension of the Náhan range, a continuous conformable sequence from the beds of the Náhan horizon into the softer sandstones, clays and conglomerates at the top of the series. The line of disturbance which in the Náhan region resulted in a denuded scarp against which the topmost beds were deposited by overlap, produced in the Satlaj region an anticlinal flexure which must have been so gradually evolved that the deposits accumulating along its southern base were sensibly conformable throughout, although now we find the uppermost conglomerates almost vertical, with a southerly underlie, at the edge of the Dún. Thus it is evident that a well-defined break is not a general feature in the Sub-Himálayan rock-series, and that it would be premature so far to sever such a portion of it by a separate name from the time-honoured Siwáliks. The name Náhan is already current in print, and may at present be understood to indicate lower Siwálik rocks. It is important, however, to point out that the real inference from the unconformable junction is of more interest than the *primá facie* one; without it we should not have had distinct proof that slow disturbance of great amount took place in the Sub-Himálayan zone during the formation of the Siwálik deposits.

A division maintained through the character of the rocks and fossils . upper Siwáliks.

Although the marked separation of groups suggested by the peculiar feature of the hills between the Kayarda and Pinjor dúns is not maintainable westwards, there is a uniformity of change throughout the series from base to top whereby approximate horizons are assignable. Conglomerates and gravels prevail at the top, variably associated with brown sandy clays. In many clear sections the thickness is quite 4,000 to 5,000 feet. It is not, however, to be understood that the deposits were ever strictly superimposed to that depth vertically. The mode of deposition in successive banks, each trailing upon and thinning out beyond its predecessor, as pointed out above for the section on the Satlaj, must greatly modify the familiar meaning of the word *thickness* as regards *space:* although where such deposits become tilted up by lateral pressure, and exposed along a comparatively shallow section, the appearance is quite the same as if vertical superposition of the whole series had obtained. Nevertheless, as regards *time*, the fullest thickness must be taken into account, for each bed is truly successive to that below it. Even when raised to the vertical, those upper Siwálik strata have so fresh an appearance as to be scarcely distinguishable from the most recent deposits—from the beds of the torrent shingle or of sandy alluvium now accumulating in the dúns or on the plains. The complete justification for their distinction as an upper Siwálik group is found in the few fossils they have yielded, some of which, as *Bubalus palæindicus*, would connect them with the pleistocene deposits of the Narbuda valley rather than with the pliocene Siwáliks.

Middle Siwáliks.

The main fossiliferous zone of the Siwálik series constantly occurs beneath the thick mass of deposits noticed in the last paragraph, and it has a fairly characteristic rock-facies of its own. Massive, clear, gray; soft sandstone is decidedly the prevailing rock ; but brightly tinted clays are also often in great force. The large vertebrate remains, although mostly found in sandstone, are certainly more abundant where there are associated clays. Several thousand feet of thickness must also be assigned to this middle Siwálik group. Falconer considered this Siwálik fauna to be miocene, but palæontologists are now decidedly in favour of its pliocene affinities.

Náhan or lower Siwálik

In conformable sequence beneath the fossiliferous zone we find rocks of the same type, but having a decidedly different aspect—strong sandstones, but of a darker hue, and often highly indurated, with hard clays generally of a deep red or purple colour. Throughout the Himálayan range, east of the Satlaj, they form the flanking ridges close under the higher mountains, and inside the dúns; or at least they mostly occupy that position, for it cannot be said that middle Siwálik beds do not occur there too, as will be seen from the remarks upon structure. No fossils can be quoted from those beds, but it is believed that some existed in the original Siwálik collections. They would probably be of miocene age.

Horizontal variations in the Siwálik deposits.

One of the most interesting features in these Siwálik deposits is the variation they exhibit in relation to the position of the great river-gorges. This is most marked in the case of the upper portion of the series. The accumulation of coarse conglomerates is immensely greater in the immediate vicinity of the large rivers of the Himálayan system, and, moreover, it is only within the range of those streams that we find the beds of large rounded blocks of quartzite and other hard rocks such as are now brought down by those great torrents. In the intervals between the rivers such conglomerates as occur are formed almost exclusively of the débris of the adjoining hills, the same as are found in the minor streams now flowing from those hills; but in this position sandy clays often form the bulk of the formation. The same influence is observable in the middle group of the series, which is often conglomeratic and gravelly, or almost exclusively sandy, near the main rivers, while away from them the clays are often in great force. These facts are very observable at the Satlaj; in the gorge above Bubhor the whole of the upper group is coarsely conglomeratic, and the middle one is more or less pebbly throughout, while at seven miles to the north-west the brown sandy clays, in which the fossil *bubalus* and *camelus* were found, form three-fourths of the entire thickness of the upper group. The apparent exception in the case of the Jumna is even a more marked illustration of the fact under notice. The river now flows through the Siwálik range at many miles to the west of the gorge where it leaves the mountains; the fact being that in the elevation of the outer range the

Jumna could not erode a passage through the great accumulation of conglomerates it had formerly discharged in front of that gorge, and which now form the highest summit of the outer range. It had to work round them not in the direction of its near neighbour the Ganges, but towards the region of lesser deposition. Thus the contrast between the Siwálik strata to the east and west of the actual river-passage is so great that it has been questioned if the formations can really be the same. To the east the upper group is made of the hard shingle conglomerates, while on the same strike to the west the conglomerates are composed of local, principally lower Siwálik, débris. In the cis-Jumna Siwáliks the middle group is formed of thick masses of soft sandstones that have yielded very few fossils, while to the west clays occur largely on the same horizon, and fossils abound. The facts indicated in this paragraph are of great importance, as bearing upon the question of the mountain-formation; showing, as they clearly do, that although these deposits, to a thickness of 8,000 to 10,000 feet, are now in many places turned up to the vertical, and even inverted, yet the main features of the higher mountains must have been during the Siwálik period sensibly similar to what they are now.

Structure of the Siwálik rocks.

So far we have briefly considered the original characters of the Siwálik strata: it is necessary now to notice the features induced by disturbance. This has taken place on the grandest scale. On the right bank of the Ganges above Hardwár the gray sandstones of the middle group have a high southerly dip; and this rises gradually, through an enormous thickness of strata, to a nearly vertical underlie in the conglomerates at the outer edge of the range. A section of the same type is splendidly exposed in the gorge of the Satlaj above Bubhor, in the second range of the Sub-Himálayan hills. There is much method in the form of these flexures: they very generally affect the form known as *normal*, *i. e.*, bends in which the dip is greater on one side of the axis, and so called because of more common occurrence than the symmetrical flexure—when both dips are equal—or than the folded flexure, in which the strata on the side of the steeper dip have been pushed beyond the vertical, and so partially inverted. As an almost universal rule in this region, the steep side of these normal anticlinal flexures is turned from the mountains. From this there results the familar conformation of the Sub-Himálayan hills, presenting a scarped face to the plains and a long slope towards the interior valley. These dúns, or at least the flat longitudinal valleys which are the typical dúns, are thus structural features, not mere valleys of denudation ; they rest upon the comparatively little disturbed strata in the hollow of the synclinal flexure. The range separating the dún from the plains is formed by the anticlinal, the steep (outer) limb of which is generally broken up and denuded away, hence the south face of the range presents the scarped outcrop of the beds on the north side of the axis of flexure.

The Nún under Mussooree

In the inner ranges, where the disturbing action was greater, the normal flexure often becomes folded, with, of course, inversion of the strata. There is an instance of this fairly seen in the Nún stream under Mussooree : below the narrow gorge, through massive sandstones having a steep northerly underlie, there is a continuous section in the low banks showing the sandstone becoming pebbly, then interbedded with thin conglomerates, then with thicker and coarser beds, all having the same high northerly dip. This is undoubtedly an ascending section though apparently, according to the dip, it is a descending one, *i.e.*, the whole series is inverted. To any one who has understood these simple explanations, it will be apparent that if these conglomerates are upper Siwálik, and unless there is a fault somewhere about the mouth of the Nún gorge, the inner Sub-Himálayan range under Mussooree must be in great part made up of middle Siwálik, and not of Náhan beds ; and indeed their character would support that view. If these conglomerates of the Nún are not upper Siwálik they would form a new sub-division of the Náhan group, which could then hardly be classed as lower Siwálik. Similar conglomerates have lately been observed in this inner Sub-Himálayan zone east of Naini Tál. It is however to be remarked that these folded flexures often are attended by great faulting, on such a scale that all appearance of flexure is lost and we only find a section of upper Siwáliks dipping against, and apparently passing under, beds of the Náhan type. There are several grand instances of such faults in the broad area of Sub-Himálayan rocks beyond the Satlaj in the Kángra region and on through the Jammu hills. They run quite straight or in very open curves for several scores of miles, and as the dislocation lessens, the unfaulted flexure is gradually disclosed. The section in the Nún shows us that to the east as well as to the west flexures may take the place of the peculiar unconformable overlapping boundary between the upper and lower Siwáliks described in the Náhan region, where there is no dún. The difference of structure would be such as might result from the presence of some unyielding mass of rock underground in this latter position, preventing the formation of flexures. This Náhan region is in other ways remarkable, as we shall see in following sections.

The form of the structural features prevailing in the Sub-Himálayan zone indicates plainly a thrust from the adjoining mountain mass; and the magnitude of the total movement is astonishing in connection with the reflection made in a previous section, that it must in great part have occurred since the mountain mass had assumed somewhat of its present form; or, at least, that the main drainage system had remained the same throughout.

Distribution of Siwálik rocks.

From what has already been said, a general idea might be formed of the distribution of the different groups of the Siwálik series; but the effects of denudation and other influences remain to be indicated. The chief expanse of the Sub-Himálayan hills and rocks is beyond the Satlaj. From about Pinjor, the lower Himálayan ranges trend northwards towards the lofty gneissic ridge of the Dhauladhár, overlooking the Kángra Dún. The outer range of the Sub-Himálayan is not affected by this change of direction, so that the zone of tertiary rocks becomes permanently widened to about three times the breadth it exhibits along the whole mountain range to the east. In the Kángra region there is a succession of three dúns occupied by conglomerates, separated by ridges of sandstone brought up along great faults. To as far as the Ganges the upper Siwáliks are still well represented in the outer hills; but east of this river, along the whole of Rohilkhand, only remnants of these outer Siwáliks have been observed. They seem to have been mostly denuded away, and one comes at once upon the older sandstones of the ranges immediately flanking the high mountains. This is the case under Naini Tál. The change, however, is not a permanent one; for, again, far to the east, on the road to

Káthmándu, there is a broad outer Siwálik range, formed of soft sandstones and conglomerates, and separated by a dún from an inner zone of lower sandstones. But, again, along the Sikkim and Bhután border, there is no sign of the outer Sub-Himálayan range.

Post-tertiary deposits

It has been said above that the uppermost Siwálik strata are considered to be of newer pliocene age, and we have seen modern deposits being laid down against them along the base of the hills in the *bhábar* region. In these a fossil village was dug out by Colonel Cautley in the excavations for the Eastern Jumna Canal. They no doubt passed down into beds of the *prehistorical* or *recent* period. Still there would be a great gap left in the sequence of formations—the whole of the pleistocene period, represented in Europe by the drift, and the cave deposits, which for years past attracted so much attention in connection with the discovery of human remains. For some middle portion of that period representatives are found in the Sub-Himálayan zone. They are unmistakably exposed on the Satlaj, above Bubhor, where the hills on either side of the river, to a height of some 500 feet, are capped by clays and coarse conglomerates, resting quite undisturbed on the edges of vertical Siwálik strata, both of the middle and uppermost groups. It is clear that a long *time of disturbance and denudation must have intervened between* the deposition of those totally unconformable deposits; also that those high-level conglomerates are separated from recent deposits by at least the time it has taken the Satlaj to excavate its gorge to its present depth. These two limiting tests of age are quite as cogent as those applied to corresponding deposits in Europe. Beds of the same age are well exposed above the sanction section already described in the Nún river under Mussooree. They are here quite on a level with the summits of the Siwálik hills to south of the Dehra Dún.

Supposed glacial deposits.

The most interesting deposits of this age are those to which a glacial origin has been assigned. It was long since observed that the glaciers of the Himálaya had once extended to a much lower level than they do now. Unmistakable moraines are found in Sikkim to within 8,000 feet of the sea level, the present limit of glaciers being about 14,000 feet. More recently a glacial deposit has been described in the Kángra valley. Enormous blocks of gneiss are freely scattered in the low ground, at an elevation of 2,500 to 3,000 feet, along the whole base of the Dhauladhár range, resting on the Siwálik strata. One cannot well assign a limit to the mass that may be moved by a rush of water on a considerable slope; but the distribution of these blocks makes it very difficult to account for them by any action of this kind through the existing gorges; for they occur along the slope of the flanking ridges, seemingly quite out of reach of any possible sweep of the torrents. They are three possible assumptions to account for their position: by supposing the scarp of the gneiss now forming the mountain-ridge to have once extended a couple of miles in advance of where it is now, and so as to bring those blocks within the range of its talus, but in this case the blocks should be found over the intermediate heights, which is not the case; or to admit that the blocks were ice-borne, and not by glaciers, for the blocks are not arranged in moraine fashion, but by floating ice in a lake of that period; or to suppose that the whole valley and the main gorges were formerly choked up with detrital accumulations to such a level as may have brought these lateral positions within the range of the spill from the gorges, ever overtopping the lower flanking hills. This is by no means a gratuitous supposition, for we find those coarse superficial deposits capping the heights above Kángra fort, on the south of the valley, and not derivable from the Siwálik conglomerates on which they rest. The necessary slope of deposition for such materials, from this position to the mountain range, would give elevation enough there for any observed distribution of the great blocks, by simple diluvial action. This is probably the real history of the case; but the possible influence of ice action to aid the process is not to be lost sight of. When the Himálayan glaciers reached to 8,000 feet lower than at present, ice-work must have been very active in the Dhauladhár, and its effects very marked in the deposits at the base of the range. All the facts suggest that those high-level gravels are of the same age throughout the Himálayan border, and probably of the same age as the former extension of glacial action; and it is impossible not to notice the near coincidence of this age with that of the glacial period of Europe. There is no independent evidence of changes of level since the age of these deposits ; and it is doubtful how far mere difference of rainfall could count for the change ; we should thus be driven to entertain the idea of an ice-age.

Importance of the theory.

The confirmation of this physical evidence of a great phenomenon having affected synchronously so large a portion of the earth's surface would be of the highest importance to geological science. Since the abandonment of the primitive idea that all similar rocks were of contemporaneous origin, we have been at a loss for any test of absolute time-horizons. Within continuous land areas some approach to a judgment can be made by closely comparing series of adjoining sections, but for any distant or detached area we have to trust to palæontology for the homotaxis, or comparative classification, of formations. Palæontological homotaxis, however, implies difference as well as correspondence in actual time relations ; and the problem of settling, from fossil evidence only, in which direction the difference should be counted, is an exceedingly complex undertaking. Thus palæontology itself was the chief sufferer by the natural limitation of age-tests for the stratigraphical foundation upon which it was based, and of which it is as yet far from being independent. And as the history of life upon the globe is the object of the highest interest in geology, the check to progress was a very serious one. The occurrence of even one semi-universal phenomenon, leaving such peculiar and well-marked stratigraphical characters as those of an ice-period, would afford an invaluable test whereby to check the direction of growth and distribution of organic forms in all the formations nearly connected therewith.

The lower Himálayan region.

The change from the Sub-Himálayan hills to the outer region of the mountains is always, as has been shown, a more marked feature than the mere difference of height would suggest. The hills of the Náhan zone range from 3,000 to nearly 5,000 feet, while the summits of the adjoining mountain-ridge vary from 6,000 to 8,000. From this to the great snowy range there lies a tract more than fifty miles wide, of deep valleys and narrow ridges, the average elevation of which would be scarcely over that of the border-zone of mountains. This is the region appropriately known as the lower or outer Himálaya. The main watershed of this broad tract of mountains lies well to the north of the line of snowy peaks, and the great rivers traverse the lower hills in very tortuous courses. The configuration stamped upon the area by the denudation from rain and rivers gives very little clue to the rock-structure. Although the general strike of the formations is parallel to that of the range, the composition of the strata is too complex, and the cases of local distortion too frequent, to admit of anything like the regularity of feature that has been described in the Sub-Himálayan zone. One character may, however, be noticed as constant throughout the western part of the lower Himálaya to as far east as the Nepál frontier : along the outermost zone there occurs a strong limestone formation, producing ridges of more rugged outline and having a greater elevation than the hills for some distance to the north of it. Our knowledge of this immense stretch of mountains is so fragmentary that no connected account can be given of it. We can only give a sketch of the four sections that have been even cursorily observed, and offer some conjectures as to their connection. The four sections occur in the Simla region, the Kumaon region, Nepál and Sikkim.

The Simla region.

The first thing to note of the Simla region is that it constitutes the termination of the Lower Himálaya as characterised above. In describing the Sub-Himálayan zone it was noted how from about Pinjor (on the main road to Simla) the boundary of the mountains trended round to the north for about eighty miles, up to the base of the Dhauladhár ridge, which is exactly on the line of the great snowy range, and is structurally its equivalent. Thus, of course, the continuous broad area of lower mountains is cut off. It is important to notice that this is not a freak of denudation, a great bay worn into the mountains by a tertiary sea : were this the case, we should find the successive formations of the area striking out along that curve and abruptly cut off there. The fact is not so. The strike of the rocks bends regularly with the direction of the boundary, thus showing that the entire feature is an original character of the mountain-structure. We have here, in the extinction of the Outer Himálayan region, the beginning of the north-westerly decrease of the Himálayan elevation. The mountains beyond the Ravi, which, in a superficial sense—as being south of the range of maximum elevation—might be held to represent the Lower Himálaya, do not reproduce its characters. Kashmír has structurally more relation to the Central Himálaya than to anything south of the snowy range. This fact of diminishing original elevation comes out very clearly in the peculiar distribution of some of the formations that occur in the Simla region. These have been roughly classified as below :—

Sirmur ... { Kasauli.
Dagshái.
Subáthu (nummulitic).
Krol (? triassic).
Infra-Krol.
Blaini.
Infra-Blaini.
Schists and gneiss.

The Sirmur formation.

The marked change in the surface configuration from the Sub-Himálayan to the Lower Himálayan hills introduces for the most part a total change of rocks. Below Mussooree and Naini Tál, and throughout the whole range to eastward, one steps at once and for good from the upper tertiary sandstone to the much older slaty rocks. It is not so, however, in the region between the Jumna and the Satlaj. The high ridge on which stand the stations of Kasauli and Dagshái is formed of rocks very similar in character to those of the Náhan zone close by ; but the marked boundary separating them is continuous with that forming to the east the separation of the Náhan from the slates. Indeed even here, under Kasauli, the slates often appear along the boundary beneath the sandstones of the ridge, which have been upheaved upon a basement of their supporting rock. Resting upon the slates in this position we find thick beds of dull brown, gray, and olive indurated clays with bands of limestone, in which there occur abundantly fossils characteristic of the nummulitic period. These beds are well seen about Subáthu. They are overlaid conformably and with alternating transition by red clays with hard purple and gray sandstone, well seen about Dagshái. In the ascending section sandstone prevails to the exclusion of the red clays, as is well seen on the ridge at Kasauli. In these top beds numerous leaves have been found indicating the proximity of an abundant sub-tropical vegetation. The aggregate thickness of this threefold formation (Subáthu, Dagshái, and Kasauli) may be from 2,000 to 3,000 feet. Collectively it may be known as the Sirmur series, a considerable part of its area occurring within that State.

Its distribution.

Here, then, at last we have a formation the horizon of which is fixed by a well-marked marine fauna. The Subáthu group at the base of this series is certainly eocene ; and considering the perfectly transitional character of the three groups, we may provisionally consider the whole series to be of this age. The study of its position and relations seems to throw much light upon the history of the mountain-system. It forms an almost isolated outlier, caught up on the edge of the mountain-area. Its greatest width, east of Dagshái, is about ten miles. In that direction it stops out along the crest of a ridge at about fifteen miles west of the Jumna ; the mode of termination showing that it was effected simply by greater elevation to the east, and consequent denudation. The only other known occurrence of these rocks within the south Himálayan boundary to eastwards is a small patch of Subáthu beds on the top of the ridge east of the Ganges close to the village of Bon in Garhwál. In the far east, however, the nummulitic deposits at the south base of the Gáro hills have a very striking resemblance to the Subáthu beds ; but it is doubtful if they were ever connected. To the west, at the Satlaj, the outlier is attenuated to a band a few yards wide—a bottom remnant of the Subáthu beds. These rocks again appear in some force in the ridge beyond, but become gradually depressed in that direction, so that before reaching the Biás the most characteristic bottom group has disappeared. The band as represented by the upper groups is well marked, though very narrow, at the Ravi. The hill station of Dharmsála stands upon it.

Its unconformity to the older rocks.

Some points of interest have been made out regarding the relations between the Sirmur series and the contiguous older formations. There is very deep unconformity : the Subáthu beds do not rest upon the next youngest rock, which is the great Krol limestone, but upon beds which underlie that limestone. This is fully made out. As a natural concomitant, we find that the surface of contact of the two contrasting formations is a very uneven one. On the ridge at Subáthu there are not more than 50 feet of the typical Subáthu beds below the red rocks ; while in the valley alongside there must be 600 to 800 feet of this bottom group. These facts suggest proximity to the edge of deposition of the nummulitic sea ; and the succeeding deposits, ending in the plant-beds of the Kasauli zone, tend to confirm the view.

Contortion of the slates post-eocene.

It seems, too, that little or none of the contortion which now affects all the rocks had occurred before the deposition of the Subáthu beds ; for at Subáthu itself a characteristic bottom layer is clearly seen, resting continuously throughout a considerable synclinal flexure upon approximately the same bed of the supporting slates. In agreement with this observation, we now find these rocks to have undergone equal contortion with the slates. The inner boundary of the eocene area is a very broken one ; and outlying shreds of the nummulitic clays are found caught up in folds of the slates, as may be seen on the road north of the Haripur rest-house.

Inferences.

All these facts would tend to prove that although some general elevation of the mountain area, involving deep denudation of the rocks, had occurred here prior to the tertiary period, none of the special disturbance characteristic of the existing mountain-system, and so specially marked in this fringing zone, took place till after the deposition of the eocene rocks. The Sirmur series exhibits more intense and varied disturbance than is at all general in the Náhan group.

Relation of Sirmur and Siwálik series.

The relation of the Sirmur to the Náhan group cannot be so definitely made out, as they are only seen near each other along a single steep line of boundary ; and the question is, as to the nature of this boundary. The argument for the total separation of the groups in this region appears, however, to be pretty conclusive. Although, as has been said, the rocks of the upper Sirmur groups have a strong lithological resemblance to those of the Náhan group—so much so that the type of the Sub-Himálayan deposits may be said to have set in with the eocenes—the facies of the Náhan and Sirmur groups are so distinct, in close proximity, that there is little ground for considering any parts of them, as represented in this Jumna-Satlaj region, to be equivalent. It is only on the supposition of the boundary between the areas (which is also the chief boundary along the base of the mountains) being a great fault, that the question of correspondence can arise at all. But as this supposition is the *primá facie* one—the one that would be applied from the accepted interpretation of like boundaries in other mountain regions—it is necessary to state the evidence against it.

Probable unconformity.

Throughout the whole range of the Náhan zone in this region no trace of the very characteristic Subáthu beds has been found, either at the apparent local base of the section, or as a remnant adhering along the supposed fault-ground. In the former position it might be said we should be more likely to find the top rocks of the older group; but this too can be answered negatively: the lower we get in the Náhan group, we find clays to occur more frequently, whereas the Kasauli beds are almost exclusively sandstones. It is also to be noted that no remnant of the Náhan rocks has been recognised capping the Kasauli beds, or otherwise, within the eocene area. No conglomerate has been observed in the Sirmur group. The only position from which the original continuity of the groups, with separation by faulting, could be maintained, would be to assert that, as the actual base of the Náhan group has never been seen in this region, the whole eocene group may be buried beneath it in conformable sequence, or otherwise; and correspondingly, that any trace of the Náhan deposits had been washed away from the present eocene area. So much for the direct evidence. As to the indirect, there is really little, except the fact of abruptness, in the character of the boundary itself to countenance the supposition of a great fault. A straight line drawn from the west end of the eocene area in Sirmur to the small nummulitic outlier east of the Ganges would touch the Siwálik hills south of Dehra; and along the great bay-like course of the boundary, north of that line, there are many sharp changes of direction, such as are not supposed to be compatible with dislocations of such dimensions as would be required in this case. The great faults in the Sub-Himálayan zone were seen to be remarkably straight. The alternative and most probable supposition is that the eocene area was upraised, and something approaching to the present steep edge of contact eroded out of it, before the deposition of the Náhan rocks.

Change of character to the north-west.

It is, however, to be mentioned that far to the north-west there is complete transition throughout the tertiary series, from the Subáthu to the top Siwálik. The partial obliteration of the Sirmur series, as forming a sharply defined zone at the base of the mountains, commences at some fifty miles beyond the Ravi about Udampur. The zone is there more than twenty miles broad, and rocks of Siwálik aspect occur within it. Still as a zone of greater upheaval it is traceable to beyond the Púnch; but before reaching the Jhilam it is quite effaced, the whole tertiary series sweeping across it in an anticlinal flexure. These facts do not in the least disturb our conclusions regarding the relation of the lower and upper tertiary series in the Lower Himálayan region. They only form part of the concurrent evidence that towards the middle of the Himálayan system the elevation was greater, and commenced earlier than in the terminal region. The same fact is emphatically shown in the comparative relation of the Sirmurs to the older rocks in these two positions. In this case there can be no doubt of the deep unconformity in the Simla region—a relation of the same kind as that here adopted for the Sirmur-Náhan relation in the same area. But this feature too is quite changed to the north-west: in the great inliers of old limestone that occur within the tertiary area of the Jamu hills, the Subáthu group, with the *same characteristic bottom-bed* as noticed at Subáthu, is everywhere observed in parallel (conformable) superposition with the old limestone. It is not indeed proven that this rock represents the Krol formation; nevertheless, the contrast of the stratigraphical relation is most striking.

Older rocks of the Simla region.

We have again to refer to the Jumna-Satlaj ground for the best sections of the next older rocks to the eocene. The peculiarities of this region come out stronger as we recede in time. Its character in the plains, as the present main watershed of Hindustan, is really its least permanent feature: there is some reason to think that the Jumna once upon a time may have flowed towards the Indus through western Rajputána. It can certainly be affirmed that such a course was within the range of the diluvial conditions that formerly obtained in upper India. The peculiar unconformity found in this position between the upper tertiary rocks is not, like the plains' watershed, accidental or temporary, but structural. In the well-preserved sections of the Sirmur group we found in this region the only representative of the eocene period within the Southern Himálaya; and again here we find the best preserved remains of the older formations. This ground too has been examined in more detail, so it will serve as a standard of comparison.

Standard section.

The Solan rest-house on the new road to Simla stands between three picturesque mountains of limestone, more or less isolated in each case upon a base of supporting rock. It is a blue gray stone, several hundred feet in thickness. From its position here we are safe in taking it as the youngest group of the series with which it is connected. It has now for some years been spoken of as the Krol limestone. There is often a band of coarse sandstone at the base of it, which seems to vary a good deal in thickness, often at the expense of the limestone. Below this there is well exposed in this neighbourhood a thick band of black carbonaceous slaty shales, which pass down into similar non-carbonaceous flaggy beds, forming the whole base of the mountains in this zone, down to the lowest levels. At a thousand feet or more from the base of the Krol limestone there occurs in those slaty flags a thin band of compact limestone of clear pink, yellow, or gray tints, often accompanied by a bed of conglomerate, and a white quartzite. This band, though a thin one, seems to be very persistent to great distances; it is therefore important as a well-marked horizon. It has been identified on the flanks of the hills under Simla; far up the valley of the Tons, at the crossing of the Simla-Mussooree road; on the Ganges near Tapuban, and again on the hillside north of the Kota Dún in Kumaon. It is called the Blaini group. The Krol group is traceable eastwards almost continuously, and in about the same condition as at the Krol, through Deoban in Jaunsár to Mussooree and Naini Tál.

Conjectured affinities.

From certain lithological resemblances to the rocks in Spiti, which he had classified from fossil evidence, Dr. Stolickza has conjectured that the Bláini and *infra*-Blaini beds may correspond with members of his Muth and Bhábe series, of upper and lower silurian age; that the Krol group represents his Lilang series, which is triassic; and that the *infra*-Krol may correspond with his Kuling series of the carboniferous period, in the central Himálaya. But no recognizable fossil has yet been found in these rocks in the lower Himálayan region.

Extension to Simla.

The relation of this series, which forms so continuously the outermost zone of the lower Himálaya, to the metamorphic rocks on the north is very puzzling, yet essential to the explanation of the mountain structure. Some important hints towards it are found in the Simla region. Unless one chances to stumble upon an outcrop of the Blaini group, the flaggy slates of the *infra*-Krol and *infra*-Blaini horizons are indistinguishable. Immediately north of the Krol there is a compressed anticlinal flexure, with elevation to the north of it; so that the slaty rocks occupy the whole ground till we reach the quartzites of Tara Devi and Boileauganj, which dip towards their common synclinal axis at the gap south of Simla: limestone occurs above them on Jutog. These may represent the Krol group. However this may be, there can be no doubt about the identification of the Blaini group on the spur under the Yarrows and under Chota Simla, on the opposite sides of Jako. The thickness of strata above these outcrops, to the top of Jako, would quite carry the section up to the base of the Krol group.

Typical instance of overlying metamorphism at Simla.

An interesting feature of the section is that the rocks of the Jako and Boileauganj hills are highly metamorphic—mica-schists and garnetiferous hornblende-schists with abundance of vein-quartz—while the flaggy slates above and below the Blaini group, all round the west, north and east base of the hill, are as little metamorphic as on the base of the Krol. This is a crucial instance of a phenomenon that meets us far and wide throughout the Himálaya, the superposition of highly metamorphic upon non-metamorphic strata. The metamorphism is often apparently greater than here—we find gneiss instead of crystalline schists at top—while the case for superposition is less distinct; so that it is possible to doubt the fact of its being a normal ascending section; and accordingly this has always been a chief stumbling-block in the interpretation of the lower Himálayan sections. It is the feature that so fatally puzzled Herbert fifty years ago. We shall have to return to the subject presently, and would only remark here that the very instructive instance we have just seen occurs in a much frequented position, where many English people pass many idle hours.

Section along ridge north of Simla.

The same flaggy slates seem to continue for a long way north of Simla, for the most part with a moderate north-easterly inclination. There are several lines of crush and strain, generally found at the gaps, but apparently unattended by great dislocation, for no new rock appears along these lines. The Blaini group has been identified on the ridge north of Theog bringing in the Krol beds towards Matiáni, where there are symptoms of gradual general metamorphism. At Nágkanda this change is very decided, and here those slaty schists seem to pass into the flanks of Hatu, the top of which is formed of massive beds of gneiss, lying nearly horizontally. This rock is the same as the so-called *central gneiss* forming the southern basement of the great snowy range, where its chief characteristic seems to be the prevalence in it of ramifying veins of albite-granite. These observations have suggested that the Krol beds had here overlapped the slate series, and are in original contact with the gneiss.

Parallel section in the Satlaj valley.

We have now seen a general section up to the great mountain range. It is taken for the most part along the watershed in a north-east-by-east direction from Simla. The apparent simplicity of it is very encouraging; but we have not far to go to dispel this illusion. It may be noted that no limestone appears on this section beyond Simla. The Sháli mountain, however, only a few miles to the west of Matiáni, is made of strong limestone, not unlike the Krol rock, with an accompanying sandstone, and underlaid by flaggy slates like those about Simla. If they are the same, and indeed in any case, their position is somewhat puzzling, for from Sháli they dip eastwards under the schists of Matiáni and northwards down to the Satlaj, where the limestone seems to pass under the gneiss of the Jalori ridge. It is not merely a case of dipping *towards* these metamorphic rocks; the V-shaped outcrop of the junction along the steep sides of the Satlaj gorge points up the valley, and is more or less parallel to the dip of the strata in both rocks. In the Satlaj valley above and below Suni, close to the north of Simla, the confusion of the limestones and slates is indescribable; and there is profuse trappean intrusion: whereas, on the whole section through Simla, from the plains to Nágkanda, only one small dyke has been observed. The absence of fossils in these limestone and slate rocks makes it almost impossible to settle their stratigraphical relations with any certainty.[1]

East of Simla.

The distribution of these limestones and slates is as irregular to the east as to the north of Simla. The Chor mountain—directly between Simla and Mussooree, and remarkable for being the highest summit (12,000 feet) occurring within such a short distance of the plains—is an isolated mass of gneiss. To east of it the limestone stretches again far into the mountains, along the valley of the Tons, forming Deoban hill; along the Mussooree ridge it occurs frequently, as on the Abbey and Camel's-back hills. On the top of Landaur it is mixed with sandstones, and appears again by itself on the Tapuban point. The Blaini limestone and conglomerate are well seen on the flanks of the Sarkanda summit, and again in the Ganges at the confluence with the Himalgár.

The Kumaon section.

In the Kumaon section we still find the limestone and slate rocks fairly represented. The ridge of Naini Tál is a broad synclinal range, with many local fractures and contortions, like its type the Krol range. The strong limestone that forms the summits about the lake is very like the Krol rock. Here, however, and also at Mussooree, there is a good deal of trappean intrusion. In the Syámkhet valley, north of Naini Tál, trap-rock is in great force, and immediately to the north we come upon crystalline schists. Along the heights of Sunthala and Gágar these are gneissose. The dip throughout is at a moderate angle to north-north-east, and about Almora one or more bands of granitoid gneiss occur in these rocks. Its general mode of appearance is that of interstratification with the schists; but in one place it has been described as intrusive, which would establish its character as a true granite. North of this, for some way, there is a reversal of the dip to south-south-west up to a line of trappean intrusion, which has been traced for many miles along the strike. The rocks to the north of this band are of a more varied character; some are slaty; and limestone is of frequent occurrence, often steatitic in the vicinity of the trap. The dip is less constant in these rocks, and their relation to the crystalline schists of the snowy range is not well defined.

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[1] Much detail with suggestive conjectures regarding this region is given in Memoirs of the Geological Survey of India, Vol. III., Part 2.

The Nepál section

Where we next get a section of the lower Himálaya through the Nepál valley, there is little outward resemblance to what we have seen to the west. The Chúria Ghátí range, between the plains and the Etounra Dún, is a pattern specimen of the Siwálik type. North of the Dún there is an equally characteristic representative of the Náhan range flanking the mountains. But inside this we no longer find the border mountain-range of slaty rocks capped by plain blue limestone that is so constant to the west of the Káli. We come at once upon schistose rocks. These, however, are not mica schists of the ordinary type, such as those north of Naini Tál. First there are earthy (slaty) schists, some quite black and with carbonaceous layers; then flaggy quartzose schists, passing up into strong schistose quartzites; and these are succeeded by a great mass of dense highly crystalline white limestone within three miles from the Náhan boundary. All are more or less vertical and folded with a prevailing northerly underlie, the strike being 15° south of east. Beyond this steep ascending section there is a broad band of still greater disturbance, apparently a synclinal; for the limestone is variously repeated, and the underlying rocks brought in again. It would seem to be followed in the Chessa-garhi ridge by a crushed anticlinal, about the axis of which there are thick bands of porphyritic gneiss associated with flaggy quartzites. From here there is again a general ascending section through similar flaggy quartzitic schists to the Chandragiri range, bounding Nepál on the south-south-west. This ridge and all those to west-north-west and east-south-east of the valley are made of folded repetitions of one set of rocks, in which a calcareous element is more or less prevalent; varying from strong beds of pure limestone to earthy schistose limestone, and prominently a thickly bedded fine-grained quartzite, with scanty calcareous bond. The Shiupuri ridge, on the north-north-east of the valley, is of massive gneiss; schists appearing again to the north in the valley of the Tádi and the Trisúl Ganga.

Possible affinities.

There is sufficient resemblance in the two bands of limestone and the underlying flaggy quartzites of this section to suggest that they are repetitions of the same series; and this has certain characters of resemblance to the rock-series at the Krol, which admit of our conjecturing their identity. The whole of this Nepál section exhibits an intensity of disturbance throughout, such as has not been observed in any other section of the lower Himálaya. Only one instance of a doubtful trap-rock has been noticed in the above section, in the schists near the outer boundary.

Sikkim section : Damuda formation.

We have one more section of the lower Himálaya to take note of, far to the east, in Sikkim, and still more unlike than that in Nepál to the sections of the north-west Himálaya. It is of the highest interest, because we find here in a recognizable state a formation well known to us in the peninsula of India, thus establishing almost the only link between these separate geological provinces. There are, indeed, the nummulitic deposits resting against the edges of the Deccan trap at the base of the western gháts to compare with the nummulitics of Subáthu, and showing that the Himálayas are younger than the Deccan plateau. But this is a comparatively superficial connexion; whereas in Sikkim we find a bottom formation of one of the great rock-series of the peninsula, intimately connected with the rock forming the mountains. It is now thirty-one years since Dr. Hooker discovered Damuda fossils near Pankabári, at the foot of the Darjeeling hills; but it was only in 1874 that an examination of the mode of occurrence of the rocks was made by Mr. F. R. Mallet, of the Geological Survey, who was sent to investigate the prospect of a useful coal being found. He traced the band of Damuda rocks from Pankabári to Dalimkot; at the Tísta it is nearly a mile in width. In the western Duárs it does not occur, but on or about its horizon there is a new formation, not found in Sikkim, consisting largely of massive dolomite, and called by Mr. Mallet the Buxa series. In 1875, Major Godwin-Austen, who accompanied the expedition into the Daphla hills, found the Damudas again in force at the base of the mountains in Upper Asám, the Buxa series being there wanting. It is, of course, possible that the Damudas may recur to the west also, in Nepál, though they do not appear at the Sikkim end of the frontier, and certainly they are not specifically represented in the section through Káthmándu.

Its condition and position.

Lithologically as well as by fossils the formation resembles its prototype in the Damuda valley, consisting of strong sandstones, gray shales, and coal seams. In some few spots the rocks are so little altered that the resemblance is complete, the coal itself being the only rock that has not escaped modification. It is always crushed to powder, and could only be utilized by being made into bricks. Very often, however, the whole group is as much altered as the contiguous rocks to the north, the sandstones being converted into foliated quartzites, and the shales into splintery slates or carbonaceous schists. The important point to settle is the stratigraphical relation of the group to the other rocks of the mountains. These are, first, a zone of slate rocks, some greenish and slightly unctuous, some ordinary clay state with bands of flaggy quartzite, rarely hornblendic and calcareous, and also rarely carbonaceous. These form the Daling series of Mr. Mallet. Next comes the gneiss of the upper hills : it is distinguished as the Darjeeling gneiss. The dip in all these rocks is into the mountain, and hence the immediate inference that they underlie each other in the above order. Here, then, we find again an instance of the puzzle noticed in the section at Simla, and on which Herbert made shipwreck. Mr Mallet was unable to find any escape from the position ; the Daling beds pass most regularly with parallel interstratification into the gneiss by increase of metamorphism, appearing underneath it all up the gorges of the Tísta and the Ranjít to the north of Darjeeling, but in a more altered condition. Also he found in several clear sections most completely conformable and transitional junction between the Daling and the Damuda beds. Their junction forms a re-entering angle up the Tísta valley ; the Damudas, however, are not known to rise to the surface again in the interior of the mountains. The conviction was forced upon him that they are indeed what they appear to be,—the lowest and oldest rocks of the Himálayan series in this position.

Theoretical considerations.

Yet so great is the prepossession in favour of gneiss as necessarily a fundamental rock, that doubt still prevails amongst those who have not seen for themselves. It may then be well to mention some independent considerations which tend to remove this obstruction to the *rationale* of Himálayan geology. It has long since been shown experimentally that the silicious minerals entering into the composition of crystalline rocks can, through the medium of moisture, be produced under very moderate temperature and pressure ; and, hence, that the hydro-metamorphism to which gneiss and even granite were due need not be a very plutonic operation. Also it can be urged that although when gneiss occurs extensively on the flat, we may be entitled to regard it as a fundamental rock, due to such hypogene action as would require any underlying rock to exhibit as great a degree of metamorphism as itself, yet when we come to mountain formation the case is very different. Here a special concentration of forces has manifestly occurred which may be adequate to the production of this apparently anomalous result. In a recent and very thorough discussion of this branch of geological dynamics we find a direct explanation of our difficulty; that if a mixed mass of strata were subjected to compression, those portions which by position or texture were least capable of yielding, whether by shrinkage or contortion, would have to bear the brunt of the pressure, and to undergo in some other form its effects, prominently in the development of internal heat.[1] In some such way overlying massive strata may have been converted into gneiss, while softer beds below underwent no crystalline metamorphism. If it should be shown, as in the Simla region, that the Darjeeling gneiss is the same as the central gneiss, the above interpretation of the Sikkim section would have to be abandoned.

Slight correspondence between the rocks of the Himálaya and of the Peninsula.

Geologists in India have been long on the look-out for a connecting link between the rocks of the Peninsula and of the Himálaya. So many of the formations in the former region are unfossiliferous, it was hoped that some clue to their homotaxis might be obtained through their representatives in adjoining regions; and although the elevation of those mountains may have occurred in tertiary times, the rocks so upraised might, of course, be of any age. Thus this discovery of the Damudas, as apparently the oldest formation in the Lower Himálaya, at least in the east, comes rather as a surprise. Although the Damuda series is, according to the most recent estimate of its fossils, of lower mesozoic age, its appearance in the field amongst other Indian formations is one of comparative youthfulness. It is, for instance, immensely younger than the great Vindhyan formation, which cover such large areas in undisturbed stratification, but in which as yet no trace of life has been observed, and below which there are several groups of slaty and sub-metamorphic rocks before we come to the fundamental gneiss of the region. However, in these matters, what is, is best; the object being to know what really has occurred. If the Himálayan sections would reflect to the geology of the Peninsula some light in return for that it has now received therefrom, by clearing up the doubts that still exist about the age of the Damuda formation, it is all we could expect.

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[1] See R. Mallet on Volcanic Energy, Phil. Trans., Vol. CLXIII., page 147.

Frequent occurrence of carbonaceous deposits throughout the Lower Himálaya.

There is but one character found almost constantly throughout the Lower Himálayan sections—the frequent appearance of carbonaceous matter. It may be of no great significance, but it is worth notice. Coal-mining had been attempted near Subáthu in the carbonaceous shale of the *infra*-Krol group, or rather where this rock has been compressed and glazed in fault-ground. And this appearance of carbon (some of it as volatile hydro-carbons) with fault-rock is very common throughout the Lower Himálaya. It occurs at Simla, below Nágkanda, at Mussooree, and east of the Ganges. Among the more highly metamorphosed rocks it is represented by graphite, as about Almora. Its appearance in the Káthmandu section, at the outer fringe of the mountains, next the tertiary sandstones, is about the only specific similarity between this section and that in Sikkim, where carbonaceous matter occurs in the Daling and the Buxa, as well as the Damuda horizon. It may provisionally be taken as a suggestive link of affinity between all these rocks. In this connection it is important to recall that in Dr. Stolickza's independent classification the *infra*-Krol horizon corresponds with his Central Himálayan Kuling series of carboniferous age, which is also the age assigned by some to the Damuda formation.

Conjectural affiliation of the Lower Himálayan sections.

From what we have seen of the rocks of the Lower Himálaya, there is not much prospect of a near solution of this question. The main hope is in the present manifest want of information. Immediately west of Sikkim comes Nepál, taking up the whole middle region of the Himálaya for 500 miles in length, and which through the unaccountable forbearance of our Government, is as much a forbidden land to Europeans as is Chinese Tibet. Except on the single track to Káthmándu, which has lately been traversed by a geologist visitor to the Resident, no Englishman dare set foot in Nepál, whose people are entirely dependent upon our good will for communication with the outside world, and freely enjoy it. In the section to Káthmándu, which is only thirty miles from the plains, we have seen a general resemblance to the rocks of the Simla region, the contrast being chiefly the universally high dips and general metamorphism. Except in this latter character it has little in common with the Sikkim section: specific resemblance in the two rock series cannot be made out. The great limestone has no equivalent in kind in the whole of Sikkim. Where distances are so great, much allowance must, however, be made for probable original change in the nature of synchronous deposits. The fact that the present base of these eastern Himálayas adjoined, or indeed formed part of the Damuda land surface, suggests a difference in the deposits near it from those at a distance. We have also had to notice all through our sections a disposition in the Krol limestone to pass into a sandy rock. In some such manner it may yet be shown that the Darjeeling gneiss is on the same horizon as the fine calcareous schists of the Nepál valley. Every geologist will understand the very precarious nature of such a speculation. As an object to confute, it may be of some service.

Consist largely of well-known formations

The Central Himálaya.—In treating of the Lower Himálaya we have had almost entirely to depend upon local names for the various rock groups, and to be satisfied with conjectural identifications of them in different parts of the ground. This unsatisfactory result is owing to the want of fossils. For a great part of that ground it must be a permanent difficulty, owing to the high state of metamorphism of the rocks; but there are large tracts where this condition does not obtain, and where we may hope that fossils will yet be found. At the snowy range and over a large part of Tibet the case is quite different. There numerous zones of strata are identifiable, not only locally, but in the established scale of formations, by the presence of well-known fossils.

Strachey, 1848-49.
Stoliczka, 1864-65.

Our information of those regions is, however, in a very fragmentary state, and must long remain so, owing to the inaccessibility of the ground and the rigours of the climate at such great elevations. Numerous travellers have crossed the mountains in various directions, and have brought back a few fossils and isolated observations of the rocks, but only two observers have given a connected geological description of any considerable area. One account is of a portion of Central Tibet in

Chinese territory, north of Kumaun visited by Captain R. Strachey, R.E., 1848 and 1849. The description is quoted *in extenso* from his paper, the map attached to which is reproduced to illustrate this chapter. The second and fuller account is that of Western Tibet, by Dr. Stolickza, published in the fifth volume of the Memoirs of the Geological Survey of India. In the summers of 1864 and 1865 he explored the region between Spiti and Drás and the Indus. It will be recollected that he died in June, 1874, after crossing the Kárakoram pass, on the return journey with the mission to Káshgár, having lost his life through his zeal for scientific research. His observations on this expedition complete a rough section across the whole Tibetan mountain region from the Panjáb to the plains of Khotan.

Western Tibet.

Dr. Stolickza's list of formations, observed in Western Tibet, is as follows :—

	Age.	*Group.*	*Fossils.*
IV.—RIVER AND LACUSTRINE DEPOSITS.			
III.—TERTIARY —	Nummulitic ...	Indus or Shingo Beds ...	*Nummulites.*
II.—SECONDARY.	Cretaceous ...	Chikkim Beds ...	*Rudista* and *Foraminifera.*
,,	Jurassic (Upper).	Gieumal Sandstone ...	*Avicula echinata.*
,,	Jurassic ..	Spiti Shales (Braun Jura).	*Ammonites macrocephalus Parkinsoni, triplicatus, etc.*
,,	Middle Lias .	Upper Tagling Limestone.	*Trochus epulus, Chemnitzia undulata, Terebratula sinemuriensis*
,,	Lower Lias .	Lower Tagling Limestone.	*Terebratula gregaria* and *pyriformis, Rhynchonella Austriaca, Belemnites.*
,,	Rhætic ...	Para Limestone ...	*Megalodon triqueter. Dicerocardium Himalayense.*
,,	Triassic (Upper).	Lilang series ...	*Halobia Lommeli, Ammonites floridus, etc.*
I.—PALÆOZOIC —	Carboniferous,	Kuling series ...	*Productus semireticulatus, Spirifer Keilhavii, etc.*
,,	Upper Silurian,	Muth series ...	*Tentaculites, Orthis, etc.*
,,	Lower Silurian	Bhábeh series ...	*Orthis ?*
GNEISS, METAMORPHIC SCHISTS, etc.			

Synclinal basins.

The distribution of these formations, though subject to many local irregularities, exhibit well the general structural features of the region. There are two main synclinal rock-basins, along the centres of which the younger members of the sedimentary series, with one important exception, are found. These geological features have no superficial relations to any geographical basins. The Indus receives a great part of the drainage from both areas in this region, flowing nearly along the intervening anticlinal axis. The southern basin is best exhibited in the Spiti valley, where the fullest section of the upper secondary formations is found. The northern synclinal-basin forms the Kárakoram range. This latter ground has been very little searched, and as yet neither oolitic nor cretaceous strata have been observed in it. Dr. Stolickza describes the Kárakoram pass as formed of liassic rocks resting upon trias.

The principal crystalline areas.

These long rock-basins are bounded by parallel areas of crystalline metamorphic rocks. The southernmost of these is that already spoken of as the central gneiss. Its peculiarity, as compared with the other crystalline ridges, is that we seem to have here what may be locally called the fundamental rock. On Dr. Stolickza's type section at the Bhábeh pass, and in General Strachey's ground, 200 miles to the east, the *infra*-Silurian rocks in a non-crystalline state, and of great thickness, are represented as overlying the gneiss. There is no doubt a parallelism of strike in the two contiguous rock-systems, but the condition suggested or implied is that the conversion of the gneiss is of pre-Silurian date; although, in the east at least, granite seems to penetrate both formations. It was in this sense of *basal* that Dr. Stolickza applied the word *central* to this gneissic axis.

Middle crystalline axis.

The gneiss and schists forming the middle region of the mountain mass, from 70 to 80 miles wide at the Pangkong and Moriri lakes, are described of a quite different type, as being largely syenitic, and as more or less made up of metamorphosed Silurian rocks. Along the north outcrop of the southern synclinal basin even the zone of carboniferous rocks is hardly recognizable, and all below it is converted into crystalline schists and gneiss, the south-westerly dip continuing in these rocks up to the Indus: similarly along the north-east side of this gneissic mass the carboniferous formation is the first that is clearly recognizable; all below it being strongly foliated and mineralized, passing with a north-easterly dip under the Káiakoram synclinal basin.

Northern crystalline axis

The gneissic axis of the Kuenluen is also described as formed chiefly of syenitic gneiss and quartzose and chloritic schists, the relation of which to the adjoining slates has not been made out. Carboniferous rocks with fossils have been observed on both sides of the range. On the northern flanks of the Kuenluen, triassic and cretaceous deposits are the only secondary formations noticed by Dr. Stoliczka.

Peculiar position of the nummulitic deposits.

Some minor features in the distribution of the several formations will be mentioned presently. We must first notice the remarkable exception, already mentioned, in the general arrangement as above sketched. The nummulitic formation occurs in great force in the Central Himálaya of Ladák, but not even approximately in sequence with the next oldest group. The cretaceous deposits are found capping the sedimentary series in the centre of the southern synclinal basin; but no trace of nummulitic beds has been noticed near them. These occur in force along the valley of the Indus, in the centre of the middle gneissic area. Dr. Stoliczka remarked how strongly the rocks resemble these of the same eocene age at the south margin of the mountains, especially those of the Dagshái and Subáthu groups. It may also be noticed how similar the stratigraphical conditions are in both positions. In the Simla region we saw that the Subáthu beds were deeply unconformable to the contiguous formations, the youngest of which is thought to be triassic. In the Central Himálaya the unconformity is even more striking, because the upper secondary period is well represented, yet the succeeding lower tertiary rocks are in a totally independent basin of deposition. Stoliczka estimates their thickness at 5,000 feet.

Extensive post-eocene eruptive rock

There is yet another formation to be mentioned in the Central Himálaya. We have seen granite in connection with the central gneiss. Stoliczka frequently notices greenstone as locally associated obscurely with the Silurian rocks; and intrusive trap (much of it of presumably tertiary age) is occasionally, as has been said, very abundant in the lower Himálayan rocks. There is, however, one exhibition of eruptive rocks in the Central Himálaya that calls for special notice. It occurs in the middle gneissic zone, locally forming the axis of a mountain range. It is more than ten miles wide at the Hanle valley, and is continuous thence, with a variable thickness on the south edge of the eocene rocks, to Kargil. Stoliczka describes it as an epidote, diallage and serpentine rock. It appears to be, at least in part, the same rock which he speaks of as syenite to the west of Kargil, where the nummulitic rocks stop out. The eruptive rock there gets entangled in silurian schists, and becomes quartziferous. This igneous rock strongly affects the eocene strata and is therefore of younger date, and is probably connected with the similar rock described by General Strachey on the same strike far to the east. We were able to draw some very instructive warnings from errors of the early school of Himálayan geologists, so we must not let the moderns escape the same ordeal. On Stoliczka's first visit he did not recognise the rocks on the Upper Indus as nummulitic. In that position they are considerably altered, and he took them to be a very *old formation.* In then writing of the contiguous eruptive rock, he remarked (*l. c.*, page 128): "From their dark colours these rocks have sometimes been referred to *basalts*, but they have certainly nothing to do with these more recent volcanic rocks." His next season's work proved that they cannot be older than middle tertiary, and therefore much younger than the great basaltic formation of the Deccan. The idea of the lithological criterions of age in eruptive rocks has still a strong hold upon the German school of geologists.

Range of the nummulities.

It cannot be supposed that the rough cross section we have sketched near the west end of the Tibetan mountain mass can be taken as a type for the immense region to the east. Already within known ground, some interruptions can be pointed out to the longitudinal extension of the several structural zones. Of the continuation of the Kárakoram and Kuenluen, and even of the middle gneissic range, we may be said to know nothing. Stoliczka describes the nummulitic band as completely stopped out against the syenite at Kargil; and although this obtruding rock is at least in part of later date, it is suggested that the termination of the eocene beds here is probably aboriginal. The eastern extension of these deposits is quite unknown, save that nummulitic strata occur in the far east north of Sikkim. Some doubtful observations of them in the Changchenmo valley and about the Pankgong lake are recorded.

Range of the southern basin.

The southern synclinal basin of secondary rocks, continuous for 200 miles from Spiti to the north-west, is also interrupted in the Kargil region against an upheaval of metamorphosed palæozoic rocks. Any recurrence of regularity in this strike cannot be expected, for the whole Himálayan mountain system becomes confused there, towards the transverse gorge of the Indus, where the stratigraphy is complicated by other systems of flexure. The short break that occurs at the transverse gorge of the Satlaj between the secondary basin in Spiti and the perfectly homologous one to the east, as described by General Strachey, is also due to a transversely obtruded mass of partially metamorphosed palæozoic rocks, through which the stratigraphical continuity is so far maintained.

Extension of the central gneiss.

Although the main elevations, constituting the chain of Himálayan peaks, are sometimes, at least in this western region, formed of the older stratified rocks along the outcrop of the southern synclinal basin, the underlying, pseudo-conformable, central gneiss must be taken as the stratigraphical axis of the range. Stoliczka's type-section of it at the Satlaj and the Bhábeh pass is on the actual continuation of that described by General Strachey to the east, in a more central portion of the great Himálayan chain, where these gneissic rocks are much more prominent. The connection of this gneiss of the main chain with that forming the core of the ridges to the north-west of the Satlaj has not been proved. There are three such ridges. On the direct line of the great chain there is the Dhauladhár ridge, having an axis of coarse gneiss, with slates (probably silurian and lower) resting high on its northern shoulder and passing down into the valley of the Rávi in Chamba. But the Dhauladhár is cut off from the Bhábeh section by the deep valley of Kulu, on the upper Biás, where no massive gneiss has been observed. The Dhauladhár ridge absolutely terminates at Dalhousie, the slates sweeping round the end of the gneiss at the bend of the Rávi. Again, Stoliczka observed his 'central gneiss,' though greatly reduced, north of the

Chínáb, at the southern base of the Zánskár ridge, below the Báralácha pass. But on the south of the Chínáb valley, on the northern flanks of the Rotáng ridge, he observed slates which he conjectured to be continuous with those of the Bhábeh pass; in which case the gneiss of the Zánskár ridge can hardly be continuous with that of Bhábeh section. This ridge of the Rotáng pass is apparently from the maps the structural continuation of the Pir Panjál range, in which a coarse gneiss is again prominent. These three ridges are in a manner confluent in the mountain region of Lahul and Vazíri-Rupi, from which flow the head-waters of the Chínáb, the Rávi, and the Biás. The Bhábeh gneiss strikes into it from the east. Thus it would seem as if the main Himálayan axis broke up into three minor features of the same type in its extension to the north-west.

The Kashmír-Kistwár region.

The gneiss of the Pir Panjál passes beyond Kashmír towards Kaghán. But north-west of Kashmír, at the Zojila, the gneiss of the Zánskár ridge is extinct, the whole range being there formed of the palæozoic schists and triassic limestone, which thus roll over from the Tibetan area into Kashmír. Carboniferous limestone occurs in the valley, striking through the Marbal pass into Kistwár. Eruptive rocks have been frequently observed in Kashmír, but none of later than silurian age. The whole Kashmír-Kistwár region, between the Pir Panjál and Zánskár ranges, is very little known. Its geological affinities are with the Central Himálaya rather than with the region specially designated as the lower Himálaya, east of the Satlaj.

Central Tibet.

General Strachey's description of the Central Himálaya, towards the sources of the Indus and Satlaj, is so brief that it can be given in full in his own words, with his summary of conclusions upon the mountain-formation. A few notes are added, giving additional information or suggesting other opinions :—

"Entering the region of the crystalline schists[1] of the great line of peaks, we find the strike still remaining the same, with the dip pretty constantly to the N.-N. E. Along the lines on which

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[1] The term *crystalline schists* is often used, as above, to include gneiss. General Strachey hardly uses this latter word, which is now so much applied to distinguish the felspathic and often massive form of metamorphic rock. It is probable that some, at least, of the granite of General Strachey's description is really massive gneiss.

Granite.

the points of greatest elevation are found in this part of the range, we invariably see for a breadth of several miles, veins of granite in great abundance penetrating the schists, often cutting through them, but perhaps most frequently following the bedding of the strata, between which they seem to have been forced. The great peaks are, I think, in almost every case composed of schistose rock, but the granite-veins may be most clearly seen on the faces of the mountains to very great elevations. Kamet, one of the highest of the peaks in this region, seems, however, to be among the exceptions of this rule; its summit, which is upwards of 25,500 feet above the sea, appearing to consist of granite alone. This line of granite seems to be subdivided into several branches, distributed generally along the strike, but otherwise not very regularly (see map). It appears to consist, where I have seen it, almost entirely of veins of moderate size, and such is probably its general character in the portion of the mountains between the Satlaj and the Káli; but the veins occasionally expand into masses of considerable magnitude, and more rarely large outbursts are met with that constitute whole mountains. In the vicinity of the peak to which I have just alluded, Kamet, the granite-area is very large (see map), and a similar development of it also occurs in the vicinity of Gangotri, at the source of the sacred branch of the Ganges. The vein-granite is usually large-grained with schorl-crystals. It is very hard and durable, neither it nor the schists that accompany it being at all liable to decay. The felspar of all granites that I have seen in these mountains is white, and kyanite is of frequent occurrence in the veins.

Schists.

"The schists that accompany this granite are very hard and crystalline, and comprise all varieties of mica-schist and gneiss. Beds of highly crystalline limestones, some pure, others hardly to be distinguished by sight from mica-schist, are of frequent occurrence, and a band of such rocks seems to traverse the country near the line of greatest elevation. The strata, where penetrated by the granite, are often very much contorted, and the dip appears on the whole to increase as we approach the granite, where it reaches an angle of 45°, which it does not often exceed. Thermal springs are met with in many of the valleys along the line of granite, and in several that I am acquainted with the temperature seemed pretty regularly to be about 128° Fahr. The whole of the appearances presented by the granite and crystalline schists of the great line of peaks in this part of the mountains seem to be universally repeated throughout the whole length of the chain when we reach the region of maximum elevation ; and as we extend our examination, we still continue to find additional reasons for concluding that the general geological phenomena of the range, and the causes that have produced them, remain very similar over great distances.

Slates and conglomerates.

"In immediate succession to the crystalline schists penetrated by granite veins, we here come at once upon slaty beds overlying them, along the bottom of which, near the mica-schists and gneiss, is a line of granite-veins differing somewhat in appearance from those of the larger eruption, and not producing any great alteration in the slaty beds themselves, as is shown by the occurrence of a coarse conglomerate, the component parts of which are perfectly distinct, only a few feet above the granite. Sufficient change, however, has taken place to prevent our distinguishing much more than that the constituents of this rock are chiefly quartzose, and that it contains rounded stones of all size. I have met with this conglomerate in a similar position, and with much the same general appearance, thirty miles or so further to the east. Above these are slaty beds, in all perhaps 9,000 feet in thickness, consisting of coarse slates, grits, and limestones, all more or less affected by slaty cleavage, and all devoid of fossil remains.

Fossilliferous rocks.

"It is after reaching the top of these strata, which is rarely done at a less elevation than 14,000 feet above the sea, that we at length enter again a region of fossilliferous rocks, which extends as far as my examinations have been carried. And it is not a little wonderful to find at this immense elevation a regular succession of most of the more important formations, from the Silurian to the Tertiary Periods. The Palæozoic beds met with immediately above the slaty rocks I have just mentioned seem to have a thickness of about 6,000 feet, but it is quite possible that organic remains may extend lower than I supposed ; indeed, from the very difficult nature of the country, the precise thickness of the deposits and the limits of the different formations cannot be determined properly without a much more careful examination of the country than I was able to give it. The lower portion of these strata ~~are~~ is undoubtedly of lower Silurian age, and I am indebted to Mr. Salter for the following list of the species that he has been able to recognize on a somewhat cursory examination of my specimens.

"Among the Trilobites are—*Cheirurus* (the Silurian form of the genus), *Lichas*, *Asaphus* (only as yet found in Lower Silurian beds), *Illænus*, *Calymens*, *Prosopiscus*, *Sphærexochus*.

"Of Molluscs are—*Strophomena*, a strongly ribbed *Orthis*, *Terebratula*, *Leptæna* very like *L. depressa*, *Lingulla*, *Orthoceras*, *Cyrtoceras*, *Lituites*, *Theca*, *Bellerophon*, *Murchisonia*, *Pleurotomaria* *Raphistoma*, and *Ctenodonta*.

"Of Polyps—*Ptilodictya*, *Chætetes*.

"Also *Encrinites* and *Cystideæ*, *Tentaculites* and other Annelids and Fucoids.

"I had also an opportunity of showing these fossils to M. Barrande, who appeared to have little doubt, from their general character, that some of the beds from which they came were certainly of Lower Silurian age.

Stratification.

"The lowest beds of these Palæozoic strata consist of dark-coloured thickbedded limestones, in some places filled with corals. They are succeeded by limestones mixed with slates, in which were found the strong-ribbed *Orthis*, *Terebratula*, *Lingula*, *Bellerophon*, and fragments of *Encrinites*. Above these come flaggy limestones with grits, that contain the greater part of the *Trilobites*, *Strophomena*, *Leptæna*, *Lituites*, *Ptilodictyon*, *Cystideæ*, and Fucoids. The beds then become more argillaceous, and shales and slates mixed with an impure concretionary limestone follow. In these beds are found *Cyrtoceras* and *Orthoceras*, and amongst the nodular concretions of limestone a *Chætetes* is common. Next in order come dark-red grits, sometimes marly, containing only a few fragments of Encrinital stems. Above these, pale flesh-coloured quartzite, and finally a white quartzite, in neither of which I ever found any fossils, and which form the highest peaks of the ridges composed of the Palæozoic rock. The whole of these strata are in various degrees affected by cleavage and joints, which penetrate all the beds without regard to their mineral character, although in a somewhat less marked degree in the limestones and quartzites. That the general sequence of these strata is pretty regularly maintained, I have seen over a longitudinal extent of about fifty miles, but it appears highly probable that their development has a far greater range, as we shall also see to be the case with some of the other groups of the fossiliferous rocks.

Compared with England.

"Before passing on, I must observe the very remarkable similarity of general mineral appearance that subsists between the Silurian rocks of the Himálaya and of England. The peculiar pale tint assumed by many of these rocks answers most exactly to the descriptions given by Sir Roderick Murchison of the Silurian districts of Wales, and the characters of the concretionary limestones of both countries appear equally to correspond. Even in hand specimens the texture and appearance of the rocks and of the fossil impressions are so similar that they might most readily be mistaken one for the other. In pointing to these resemblances, however, I would not have it supposed that I should wish in any way to set up mineral character as a criterion by which to decide on the age of any rock. Nevertheless, the facts, if they are to be relied upon, would appear to indicate that as we see the conditions of the existence of organic matter to have been generally similar over large areas, or even over the whole earth, during the same epoch, and to have changed with the progress of time, so likewise has it been with the conditions under which the mineral constituents of the earth have been aggregated.

Silurian predominates.

"The Palæozoic strata that I had an opportunity of examining in detail *in situ*, which I have just been describing, appear to be exclusively Silurian, but the existence of rocks of Devonian or Carboniferous age seems to be shown by some of my specimens, not found *in situ*, which contain *Productus*, *Chonetes*, *Athyris*, *Orthis*, *Aviculopecten*, *Spirifer*. I may here be allowed to repeat that the higher portions of the Silurian rocks being usually found at elevations of 17,000 or 18,000 feet, their examination is not a very easy task, and the difficulties occasioned by the great altitude are infinitely aggravated by the confusion into which the beds are thrown by the vast dislocations that have accompanied the elevation of these mountains. In concluding my remarks on the Palæozoic beds I would observe that, as a general rule, to which, however, there are no doubt many exceptions, these rocks are to be found forming the summits of the highest passes between the British provinces of Kumaon and Garhwál and Tibet, which probably average 18,000 feet in elevation, and that the highest points of the ridges on which these passes are found not unfrequently reach nearly 20,000 feet in altitude.

Trias.

"In proceeding along the section, we shall next observe some beds very remarkable from their apparently close similarity to the Trias of Europe. I can now only regret that, not having been sufficiently aware of their importance, their exact relation to the beds below them has not been better made out; but their position in the series immediately above the Palæozoic rocks is at least certain. In one place these strata were found *in situ* intermediate between the Palæozoic and Secondary rocks, but the greater part of my specimens were obtained from fragments lying on the north slope of the Palæozoic ridge, which appears to terminate with a line of fault, to the north of which a cliff of Oolitic age suddenly rises. From these strata I have obtained not less than twenty-five species of fossil shells, which is a remarkable circumstance, considering the small bulk of the specimens that I was able to bring away with me. Mr. Salter, who has been so good as to examine these also, tells me that we have *Ammonites* several, *Ceratites, Orthoceras, Natica, Exogyra, Halobia, (Avicula), Pecten, Lima, Athyris, Waldheimia, Rynchonella, Spirifer.* The Triassic beds were chiefly dark-coloured limestones and, where seen *in situ*, were associated with shales and dark-red grits, the latter of which seemed very similar to those found near the top of the Palæozoic series. The line on which they were seen was, however, a very bad one for determining such matters, for it was in one of the great valleys, and consequently on a great dislocation where accumulations of débris almost always greatly predominate over rock *in situ*.

Jurassic series.

"In our progress northward, we next come upon the strata that form the representatives of the Jurassic group. As in the Palæozoic beds, so we here find the general dip to be to the north; but it is impossible for me to offer any opinion as to the degree of conformability of any of these deposits one to another, owing to the great disturbances to which they have everywhere been subjected. It appeared to me, however, as probable that in the parts of the mountains that I examined, a great line of fault intervened between the Oolitic and Palæozoic series. The mountain-ridge of Silurian age most carefully examined by me lies generally parallel to the line of strike, and along its north-east face runs a stream separating it from the Secondary rocks, which rise in an almost impassable precipice beyond. The section here exposed must be at least 5,000 or 6,000 feet in thickness, but the difficulties of the route prevented my extending my examinations into the lower beds. The lowest that I reached were of black limestones and shales, with very few organic remains, and those very imperfect. Above these lie several thousand feet of limestones of various descriptions, the rock in some places being almost made up of fragments of shells. Professor Forbes, who has kindly looked over my specimens from these beds, is inclined to identify some of the species with certain forms that occur in the Fuller's Earth and Cornbrash of England; and it appears that there is here no representative of the Lias.

Oxford Clay.

"Continuing to ascend in the series, we reach next a large development of dark-coloured shales which abound with remains of *Ammonites* and *Belemnites*, the former usually imbedded in spherical nodules, apparently of much the same nature as the shale itself, but exceedingly compact. The shale is for the most part, on the other hand, very rotten, and the band of country along which it is found is often depressed so as to form a valley, apparently in consequence of this disintegration of the rock. This shale Professor Forbes pronounces to be without doubt of the age of the Oxford Clay, a conclusion indicated by the peculiar forms of the *Ammonites*, two of which seem to be identical with species found in beds of the same age in Kachh and Sind, which have been figured and described in the Transactions Geol. Soc.[1] The existence of these beds in the northern parts of the Himálaya was pointed out by Sir Roderick Murchison some years ago, as proved by the occurrence of some of these *Ammonites*, which he had seen. There is indeed direct evidence of the existence of these Oxford Clay strata for a distance of about 200 miles to the westward of the places where I have myself seen them, and their prolongation along the north of the

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mountains for 200 miles more in an easterly direction is rendered highly probable by the well-attested recurrence of the *Ammonites* in the eastern parts of the kingdom of Nepál. Although we find stratified deposits apparently lying conformably on the Oxfordian strata, I cannot say anything definite regarding them, as they appear to be almost entirely devoid of fossils. They are very hard and compact, consisting of grits, shales, and limestones, and have not improbably been converted into their present state by the action of eruptive rocks which are of common occurrence in this region.[1]

[Subsequent to the publication of General Strachey's papers in the Journal of the Geological Society, a description of his collections of fossils was drawn by Messrs. Salter and H. F. Blanford, and printed for private circulation. The following complete lists are taken from that work :—

SILURIAN FOSSILS.

Asaphus emodi.
Illænus brachyonisus.
Do punctulosus.
Cheirurus mitis.
Pro-opiscus mimus
Sphæaexochus idiotes.
Lichas Tibetanus.
Calymene nivalis.
Tentaculites sp.
Serpulites sp
Nautilus ? involvens.
Cyrtoceras centrifugum.
Lituites uniformis
Orthoceras striatissimum.
Do Kemas.
Theca lineolata.
Bellerophon Ganesa.
Strophomena trachealis.
Do. chæmerops
Do. umbrella.
Do. aranea.
Do. nubigena
Do. bisecta.
Do. halo.
Do lineatissima
Orthis Thakil.
Do Tibetica

Murchisonia Himalensis
Do pagoda
Pleurotomaria turbinata.
Raphistoma emodi
Trochonema humifusa.
Cyclonema rama
Do. subtersulcata
Holopea varicosa
Do pumila.
Ctenodonta sinuosa.
Cyrtodonta ? imbricatula.
Lingula Kali.
Do. ancyloides
Leptæna Himalensis.
Do. repanda.
Do cratera.
Do nux.
Orthis compta
Do. monticula.
Do uncata
Ptilodictya ferrea.
Do. plumula.
Sphærospongia melliflua.
Do inosculans.
Chætetes ? Yak
Heliolites depauperata.

CARBONIFEROUS FOSSILS.

Productus Purdonii.
Do. Flemingii.
Chonetes Vishnu.

Athyris Roissyi.
Aviculopecten hyemalis.

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[1] In 1873 Mr. T. H Hughes, of the Geological Survey, brought some fossils from the Milam Pass They were identified by Dr Waagen as representing crestaceous, jurassic, triassic, permian, carboniferous, and silurian formations This brings the series here into fuller agreement with that described by *Stoliczka* in Western Tibet.

TRIASSIC FOSSILS

Ammonites floridus.
Do. Aon.
Do. Winterbottomi.
Do planodiscus
Do. diffissus.
Do Gaytani
Do. Ausseeanus.
Do Blanfordi
Ceratites Jacquemonti
Orthoceras pulchellum.
Do salinarium.
Natica subglobulosa

Exogyra sp
Halobia Lommeli.
Pecten scutella.
Lima Stracheyi.
Athyris Deslongchampsii.
Do Strohmeyeri
Waldheimia Stoppani.
Rhynchonella retrocita.
Spirifer Oldhami.
Do Stracheyi.
Do. Rajah.

OOLITIC FOSSILS.

Belemnites sulcatus
Amonites acucinctus
Do alatus.
Do bifrons.
Do. biplex.
Do. communis.
Do. concavus.
Do. Eugénii.
Do. Gerardi.
Do. Griffithii.
Do. guttatus
Do. Hookeri
Do heterophyllus.
Do. Himálayanus,
Do Hyphasis.
Do. Jubar.
Do. Medea.
Do Nepalensis
Do. octagonus.
Do. robustus.
Do. scriptus
Do. Spitiensis.
Do. strigilis.
Do. tenuistriatus.
Do torquatus
Do. triplicatus
Do. Thouarsensis.
Do umbo.
Do. Wallichii.
Turritella montium.
Pleurotomaria ? sp.
Turbo invitus.
Chemnitzia sp.

Anatina Avagmula
Myophoria Blanfordi.
Cardium truncatum.
Cyprina trigonalis
Astarte major
Do unilateralis.
Modiola sp
Nucula cuneiformis.
Cucullæa virgata
Do leionota.
Inoceramus Hookeri.
Lima acuta
Do gigantea
Do mytiloidea.
Monotis concentricus.
Avicula echinata
Do inæquivalvis.
Pecten æquivalvis
Do comatus.
Do. bifrons
Do. monilifer.
Do. Lens
Do. Sabal
Ostrea flabelloides.
Do acuminata
Terebratula numismalis.
Do. carinata
Do globata
Rhynconella variabilis.
Do. concinna.
Acrosalenia ?
Pentacrinites sp.]

Tertiary deposit.

"But the most striking feature of the geology of these mountains is probably that which I have next to mention, *viz.*, the existence of a great Tertiary deposit at an elevation of from 14,000 to 16,000 feet above the sea, still preserving an almost perfectly horizontal surface. On crossing the watershed-ridge between the streams that flow to the south into the Ganges, and those that fall into the upper part of the Satlaj to the north, which here constitutes the boundary between the British territory and Tibet (see map), we find ourselves on a plain

120 miles in length and varying from 15 to 60 miles in breadth, that stretches away in a north-westerly direction. Its western portion is everywhere intersected by stupendous ravines, that of the Satlaj being nearly 3,000 feet deep. The sections afforded by these enable us to see that this plain is a deposit of boulders, gravel, clay, and mud of all varieties of fineness, laid out in well-marked beds that run nearly parallel with the surface, and that hardly deviate from a horizontal position. The discovery of the fossilized remains of several of the larger mammalia distinctly marks the Tertiary age of this deposit. The existence of such fossil remains in the northern parts of these mountains had been long known, but we were altogether ignorant of the precise locality whence they came, and had no facts before us from which any conclusions could be formed as to their geological import. The Niti Pass, from which it was said that the bones had been brought, was not the place where they were found, but one of the routes only by which they came across the great Himálayan chain from unknown regions beyond.

So-called Niti fossils.

"Mr. Waterhouse, who has been so obliging as to examine the specimens that I procured from these beds, informs me that he recognizes amongst them the following :—Metacarpal bone and distal end of tibia of *Hippotherium* ; patella of small horse ; distal end of radius of a larger species of horse ; distal half of tibia of a horse of very large size ; part of metacarpal of a horse ; upper end of tibia of bovine ruminant ; dorsal vertebra of a ruminant. Portion of head of an undescribed animal allied to goat and sheep, having, like them, prominent orbits, and the horns above the orbits ; but which differs in the peculiar form the bony core of the horns. The horns are remarkable for being placed very near to each other at the base (their upper portions are broken off). There is a specimen in the British Museum, however, from the same locality, of an animal very like this, in which the horns are seen to be short, stout, and slightly bent outwards at the apex. Right wing of the atlas vertebra of rhinoceros ; phalanx of one of the outer hind toes of ditto ? ; and portion of tooth of elephant ? Specimens of the bones of ruminants, pachydermata, and other animals from this district, presented to the Society by Sir Thomas Colebrooke and Dr. Traill, are in the Museum of the Geological Society, London.

Actual site as yet not identified.

"The bones that we have hitherto obtained from these strata are almost all very miserable fragments, so that it is difficult even for the very learned naturalists that I have mentioned to do more than distinguish the genus to which they belong. It is therefore, I am afraid, at present impossible to come to any decided conclusions as to the identity or otherwise of the species here found with those of the Siwálik hills, a question of the greatest interest with reference to all our speculations on the geology of these mountains. The fossil bones I have not seen *in situ* nor indeed, curious to say, could I, in spite of every attempt, learn a definite locality in which any one knew positively that they had been found. But of the general position where they occur there can be no doubt, for, besides the common account of their being found in some of the ravines that traverse the plain, on many of the specimens quite enough of the rock in which they are imbedded has remained to enable me to recognize a fine-grained calcareous conglomerate exactly identical with beds such as I have seen intercalated with the boulder and gravel beds that constitute the mass of the deposit. Hills of limestone rise here and there above the general level of the plain, and it appears as though the calcareous matter derived from them had cemented together portions of the sands and gravels that were deposited near them.

Probably of marine origin.

"The existence of such animals as I have mentioned as being found in these beds being a physical impossibility in the present state of the country, there can be no doubt that the strata have been elevated to their present height from some lower level since the time of their deposition. There is no direct proof that these beds are marine, no shells having been obtained from them, but I think on the whole that the probabilities appear to be in favour of this plain having been a true sea-bottom rather than of having been occupied by a detached body of fresh water. The general extension of some of the older fossiliferous rocks along the northern face of the Himálaya over a great longitudinal distance is a fact of which we have tolerable proof, and it thence follows that the line on which they occur, distant about twenty or thirty miles to the north of the great line of peaks, has probably been a sea-margin from the remotest ages of the earth's history until as late as the Oolitic period at least. So far, therefore, there is nothing adverse to my supposition; nor is the present interruption of the plain any proof that it did not once have a far greater extension. This is sufficiently proved by my having traced these tertiary beds to the very top of the watershed-ridge in the vicinity of the Niti Pass, where they reach an elevation of upwards of 17,000 feet; the summit of that pass being strewn with boulders that appear to be derived from the white quartzite capping the Silurian strata of the neighbourhood. Further, two or three miles to the south of the pass, a detached portion of this deposit is to be seen on the declivity of the mountain, which must have been separated from the general mass by the dislocations that have upheaved the whole country. It is, moreover, to be noticed that there seem to be grounds for supposing that plains, such as I have mentioned, are found in other parts of the chain under somewhat similar circumstances, which may not improbably have once formed portions of the same sea-bottom. The plain of Pámír, so long known from the accounts of Marco Polo, and the existence of which is fully corroborated by Lieut. Wood of the Indian Navy, in his Narrative to his Journey to the Source of the Oxus, may be its representative to the west; while to the east the plains described by Turner as having been passed over during his embassy into Tibet, as well as others mentioned by Kirkpatrick as existing to the north of Nepál, the descriptions of which are quite confirmed by Dr. Hooker, are not improbably of a similar nature. Another argument in favour of the marine origin of this deposit is, I think, also to be derived from the very regular way in which the beds of gravel and boulders are laid out, for which I should conceive that some action like that of the tides would be requisite.[1]

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[1] No notice has been taken of these great detrital accumulations up to this, because they occur on the grandest scale in the regions described by General Strachey; but every explorer in the Ladák country has noticed deposits of the same kind. In many cases they are very recent. The process of their formation has been very well described by Mr. Drew in the Quarterly Journal of the Geological Society for 1873. From the fossils enumerated above, it is, however, certain that some of them are very ancient. The fact that General Strachey did not observe the actual site of these bones leaves it open to conjecture whether they may not occur in some disturbed beds more or less covered by these horizontal gravels; for it is very difficult to conceive how any great dislocation or upheaval of the mountains can have occurred without disarranging such incoherent materials. On the other hand the fact that such large animals as the Yak, the Kiang, the Ovis Ammon, &c., now flourish in the wild state in those bleak sterile regions suggests that a moderate change of climate, without any great change of elevation, might make them habitable for the fauna now found fossil there. No evidence for marine action later than the nummulitic period is known within the Himálayan border.

Eruptive rocks

"I have already mentioned the occurrence of eruptive rocks in the Tibetan plateau. A great outburst, in which are found hypersthene and bronzite, besides syenitic and ordinary greenstones, and various varieties of porphyry, occurs in the vicinity of the lakes which are found at the eastern extremity of the plateau (see map). The greenstone is known to extend considerably to the west, and forms, at an elevation of about 17,600 feet, the summit of Balcha, one of the Himálayan passes into Tibet which I have crossed.

General Strachey's conclusions.

"Having thus given a general description of the geology of this region, I shall, as shortly as possible, enumerate the chief conclusions to which I have been led with regard to the physical forces that have been called into action in the formation of these mountains:—

(a.)—The general extension of the chain along the direction of the strike of the strata is a phenomenon necessarily connected with the action of an upheaving force along a line. This longitudinal action is further evinced by the parallelism of the lines of *eruptive* action with that of the *strike.* The continuance of action of the upheaving forces along the same general line for a vast period of time, with occasional intervals of repose or of subsidence, is indicated along both the north and south faces of the Himálaya. *The great depth at which the forces have originated seems to be* proved by the regularity of the action along the entire length of the chain, as shown by the elevation of such a ridge as the Siwálik hills.

(b).—The granites appear to constitute lines of elevation, not of rupture; but there seems to be no specific action produced by them on the dip of the strata, which they appear to leave generally unchanged.

(c.)—The greenstones, on the other hand, usually follow lines of dislocation of the strata, being sometimes apparently contemporaneous, and at others intruded through rocks already consolidated.

(d.)—The cause of the general north-easterly direction of the dip is obscure, although its occasional sudden reversal to south-westerly seems to indicate some connexion with the action of an upheaving force from below, or of violent lateral thrust.

(*e.*)—The lines of fracture of the strata are constantly either parallel or perpendicular to the direction of the upheaving force. The positions of the rivers appear to be altogether dependent on the configuration of surface produced by these fractures; while the configuration of surface, on the other hand, seems to be but slightly affected by the action of the streams, of which there is rarely any visible sign at 200 feet above the present level of the waters, and never to my knowledge above 300 feet.

(*f.*)—The fact of the granite of the great snowy peaks being seen in veins, penetrating the schists up to 20,000 feet, makes it highly probable that the granite must have been injected long before the mountains received any considerable development. That this granite is older than the Silurian period is rendered probable by the comparatively unaltered state of the lower beds of the Azoic slates at the foot of the Palæozoic series, where almost in contact with it.

(*g.*)—The conglomerate bed near the bottom of these same Azoic slates shows the proximity of land at the time of its deposit, and indicates that some upheaval of land had already taken place near the present line of great peaks, possibly occasioned by the granite in question.

(*h.*)—The occurrence of pebbles of greenstone in the sandstones along the southern edge of the mountains shows that the exterior lines of greenstone are older than those beds of sandstone.

(*i.*)—The frequent occurrence of boulders of the quartzites, slates, and greenstones of the outer ranges of mountains among the Tertiary deposits of the Siwálik hills shows that the Tertiary ocean washed the foot of those mountains.

(*j.*)—The regular slope of the plains of Northern India up to the Siwálik hills, which rise suddenly from the flat ground, leads me to infer that the sea must have continued to reach at least as far as the foot of the Siwálik hills for some time after their upheavement.

(*k.*)—The rise of the Tibetan plain has not been caused by the granite eruption of the line of snowy peaks. That the greenstone rocks that abound in many parts of it have equally not caused it, is proved by the peculiar nature of the valleys among the hills to the west of the lakes, which must have been laid out level under water; from which it is to be inferred that these eruptive rocks are older than the tertiary beds of the plain. The same thing is shown by the occurrence of worn pebbles of greenstone in the surface of the plain in the vicinity of some of the detached hills of that rock.

(*l.*)—The former extension of the glaciers far beyond their present limits is a phenomenon that may be noticed almost everywhere in these mountains, and may give rise at first sight to an idea that there may here also have been some special period of cold corresponding to the glacial epoch of Europe. But it seems, I think, more probable that this is here only the result of a change of climate consequent on the upheaval of the great plains of Northern India.

(*m.*)—The existence of ancient moraines on the tertiary plain of Tibet proves that the extension of the glaciers is post-tertiary. Now, if we conceive that after the rising of this plain to nearly its present elevation, the sea still continued to wash the foot of the Siwálik hills, as I have already said that I considered likely, it is clear that the climate of the Himálaya would have been far more moist, and that the quantity of snow that fell on the highest parts of the mountains would have been greatly in excess of what now falls there, causing a great extension of the glaciers beyond the *limits to which they have now receded.*"

Remarks on the above summary.

There are several points in the foregoing summary that might be objected to in detail, but it is hardly necessary to point them out. With the much more extensive information now available than was at General Strachey's disposal, one ought to be able to give a more precise account of the phenomenon under discussion. But one lesson of experience is caution. From all sides the geologists of Europe have been for long years hammering at the Alps; yet the mode of formation of those mountains is still a subject of very vague speculation. What then can we expect from our fragmentary knowledge of Himálayan geology? In one respect we seem to have the advantage: the much grander scale on which the phenomenon took place, and perhaps also the less advanced stage of the process, have resulted in a somewhat less complexity of structure.

The process of investigation is to find out as far as possible from these remnants of the formations, and their relations to each other, what were the conditions of the surface at the time of deposition of each, and what successive changes of conditions occurred. Thus General Strachey's observations that the metamorphism of the rocks forming the crystalline axis and the introduction of the granite are of pre-silurian date; that this axis of elevation was a shore of deposition at that time, would be facts of prime importance in the early history of this region. It would give a prodigious antiquity to the beginning of the Himálayan mountain system, for all subsequent disturbances have conformed in elevation with that which produced the gneissic axis. It may be remarked that this view is apparently in immediate opposition to what is now a very favourite theory of mountain-formation—that which connects these areas of special contortion and elevation with a preceding long-continued accumulation of deposits, and accompanying depression, in the same area; whereby through the gradual rise of temperature in the sediments thus sunk to a considerable depth, expansion occurs, and also a softening of the rocks, including a yielding to the horizontal thrust in the earth's crust, thus producing the compression and up-squeezing into mountains of the accumlated sediments.[1] In the simple application of this process the position of greatest elevation should approximately coincide with that of the preceding greatest deposition, and not with the limit of the deposition, as we find it according to General Strachey's observation.

To this objection, and in defence of the theory, it may be very fairly argued, that the line of actual maximum elevation is due to denudation having removed the softer and more broken strata and left the more massive rock; that according to the observation under discussion, the sedimentary series never passed across this primitive gneissic axis; and that the position of greatest elevation (in the active sense of upheaval) occurred about the middle gneissic axis formed of metamorphosed palæozoic rocks, all the once overlying strata having been removed; that but for this result of denudation we should have the crest of the Himálaya to the north of the upper valley of the Indus.

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[1] Notwithstanding the numerous recent claimants to this theory, the mechanical elements of it are essentially those given by DeBeaumont in his Systèmes de Montagnes, p. 1318; the other ideas in it being due to two other equally eminent philosophical physicists, Herschel and Babbage.

The interpretation of the drainage system gives direct support to this view. It is an evident postulate of physical geology that along any line of elevation the drainage is originally transverse. The manner in which this primitive system becomes largely converted into longitudinal drainage lines is explained in every text-book on geology. Now, making the fair assumption that the initial line of elevation coincides with the maximum line of upheaval, the main watershed of the future continent is determined by that initial line, and it is presumably a very permanent feature. Every geography book notes the fact that the Himálayan watershed lies far to the north of what is more particularly described as the Himálayan range, but the line of reasoning we have just indicated would suggest that the real axis of maximum elevation in the Himálayan system may coincide more or less with the watershed. We should thus have two magnificent examples of the process of drainage-conversions above alluded to: the Indus and the Sanpo (Brahmaputra) now flow from about the same central position, having gradually worn back along the line of easiest erosion, cutting off in succession the originally transverse drainage along the whole line.

Stoliczka's views.

The applicability of this theory of mountain-formation to the Himálaya system does not, however, depend upon the correctness of General Strachey's view regarding the exceeding antiquity of the first gneissic axis. The gneiss there in early Palæozoic times may have been a floor of shallow deposition without being a range limiting that deposition. Stoliczka does not adopt this latter view though, leaving it an open question. His own provisional identification of lithologically similar Silurian rocks in equal force to the south of the axis would, perhaps, suggest their original continuity across that axis. He hazarded very few remarks upon the general geology of the Himálaya, wisely postponing such considerations until the data would warrant something definite. He points out that the deposits of carboniferous age, filling only broken ground in variable thickness, represent the close of a general geological epoch. The Permian and lower Trias are not represented. He considers that after the Trias extensive upheavements occurred, laying dry large tracts that have not since been submerged. The Jurassic basin was then approximately defined. The evidence for these conclusions is not given, and they seem difficult to reconcile with the general regularity of succession of the rocks. On his figured sections the Para limestone (Rhætic group) is the only one that exhibits great inequality of distribution, being of considerable thickness on the north side of the basin, and altogether wanting to the south. His remarks would, however, assign at least an early Mesozoic age for the origin of some of the prominent features of disturbance now stamped upon the Himálayan system.

The most notable features in the sequence of formations in the Himálaya is the position of the nummulitic deposits, as already mentioned. They are in greater thickness than any of the older formation except the lower Silurian. Stoliczka speaks of them as having been deposited in the narrow basin where they now lie in the very centre of the mountain region. This view strongly confirms that previously arrived at from the consideration of the same deposits at the south edge of the mountains: that long and extensive denudation of the Himálayan area had preceded the Tertiary epoch. It seems to have been greatest, as would naturally occur, along the centre of the area of upheaval, wearing down to the metamorphic rocks along what may then have been the back of a broad flat tuberence of the earth's crust. A comparatively slight settlement of the area, submerging only the more deeply eroded parts, would then have sufficed for the accumulation of those eocene deposits, and it seems possible that the production of the synclinal basins of the Central Himálaya—as was shown for the contortion of the infra-Krol beds of the Lower Himálaya—did not occur, or, at least, was not strongly developed till the great compression upheaval in middle Tertiary times.

CHAPTER IV.

THE HIMÁLAYA.

CONTENTS

The outer Himálaya. Mountain systems; Jumna; Ganges; Káli. Subordinate boundaries. The Nayár. Western Rámganga, Káli. The snowy range. Axis of highest elevation. The Tibetan plateau. Glaciers. Glacier of the Pindar; feeders of the glacier; moraines, crevasses and ice tables. Glacier of the Kuphini. Motion of the Pindar glacier. Snow-line. Observations in the eastern Himálaya. Observations in Kumaon. Bisahr. Across the snowy range. Kumaon; Garhwál. Kunaor; Western Tibet. Lakes.

The outer Himálaya.

We have seen that the term 'outer Himálaya' has different meanings according to the sense in which it is used. Geographers understand by it all the mountain systems lying between the snowy range and the plains of India, whilst in the western Himálaya geologists restrict its use to the limestone and slate formations that lie between the outlying tertiary series and the central crystalline axis. To the geologist Simla and Naini Tál are situate on the outer Himálaya, and Kasauli and Subáthu are not; whilst to the geographer all these hill sanitaria are on the outer Himálaya. To obtain a correct appreciation of the physical relations of the ranges of the outer Himálaya we cannot ignore their geological affinities, but we have as yet no geological details on which we can rely for the greater portion of their area. For the tract between the Tons and the Káli we have the record given in the preceding chapter and the map that accompanies it. A glance at this map will show us that the main line of gneiss and granite, which is almost conterminous with the region of perpetual snow, is met with between the eightieth and ninetieth mile from the foot of the Himálaya, and at a distance of from twenty to thirty miles south of the Indian water-parting. Between this line of perpetual snow and the plains there are numerous well-defined ranges, some seemingly spurs from the snowy axis, and of which the geological relation is not well established, and others having an apparent separate and independent existence. As we have already noticed, the traveller from the plains meets first an outer range, which has a general elevation of about 6,000 to 7,000 feet above the level of the sea, and which in Chína above Naini Tál rises to 8,568 feet, and in a peak, on the Tirhi road, east of Masúri, to 8,565 feet. This band or outer range has a general direction parallel to the plains, and is pierced by the greater rivers, such as the Tons, Jumna, Ganges, Rámganga (western), Kosi, and Káli. Between it and the ridges descending immediately from the snowy range we cross a number of subordinate ranges which are, as a rule, of considerably less elevation than the outer range. Between Chína and Dhákuri Bináyak, on the road to the Pindari glacier, a distance of forty-five miles as the crow flies, there is no peak having an elevation of 8,000 feet, and very few attaining to 7,000 feet. But further westward, in the same parallel, we have groups of peaks attaining an elevation of over 10,000 feet, notably those connected with the Dudu-ka-toli range in Garhwál. When the river valleys close to the snowy range are reached, the increase in elevation is rapid and marked. The flanking ranges seldom fall below 10,000 feet, and are crowned with peaks rising still higher, until the culminating ridge crowned with perpetual snow is met.

Mountain system.

Jumna system.

If we carefully examine the great sea of mountains lying between the outer Himálaya and the snows, we shall find that the dominating ranges are spurs from the great groups of peaks, remarkable alike for their elevation and the position they fill as the boundaries of the several river-basins. On the west, the western boundary of the Jumna system is found in the elevated ridge that has its origin in the group of peaks crossed by the Shatúl and Burenda passes. This ridge follows the left bank of the Satlaj in a south-westerly direction to Hatu (10,700 feet), where it bifurcates: one branch continuing the normal direction to Biláspur, and the second proceeding in a south-easterly direction by Chor (12,081 feet), where it forms the water-parting between the Giri and the Pábar branch of the Tons. A second great ridge, descending from the Jamnotri groups, and marked by the Deoban (9,347 feet), Chakráta (7,300 feet), Chilmeri (7,160 feet), and Bairát (7,423 feet) peaks in British territory, separates the affluents of the Tons from those of the Jumna. The eastern boundary of the Jumna system is formed by a great ridge having its origin in the same group of peaks, and which joins the outer

Ganges system.

Káli.

Himálaya near the Sarkanda peak to the east of Masúri (Mussooree). The eastern boundary of the Ganges system is found in the great ridge descending in a south-westerly direction from the Nandakot peak, and which passes along the left bank of the Pindar to its junction with the Alaknanda, and thence along the left bank of the Alaknanda to Deoprayág. It admits of two great bifurcations: one at the head of the Katyúr valley, and one at the head of the Lohba valley. From the group of peaks at the head of the Katyúr valley a branch passes in a south-easterly direction through Binsar and Dol and along the right bank of the Ladhiya to Barmdeo on the Sárda, and from the head of the Lohba valley a branch runs south-by-east to Gujargarh, whence it passes almost due west to the Ganges at Kharak and Chándi. The tract to the south of these two arms is in shape a great obtuse-angled triangle, with its base towards the plains and its apex in the group of hills to the north of Dwára Hát. It forms the mountain basin of the western Rámganga. The eastern boundary of this system forms the western boundary of the Káli system, of which the eastern boundary is found in a great ridge descending from the Api peak in Doti of Nepál. It is clear from the above brief description that it is the spurs from the snowy range that bound the river basins, and if we examine further the affluents of each system, we shall see that the ramifications from these spurs form the water-parting between each minor system.

Subordinate boundaries.

The principal affluents of the Jumna system are the Tons and the Giri. The Pábar, Rúpin, and Súpin unite to form the Tons, and are separated from each other by transverse ridges descending from the great boundary ridge. United they drain a delta-shaped basin having its apex at Kálsi. To the south-west the Giri drains a similarly shaped basin having its apex near Kálsi, and to the east the Jumna drains one having its apex at Kálsi. We find that the point of junction of the apices of these three deltaic basins lies within the Siwáliks, the outer range of geographers, and that the union of these three main affluents forms the Jumna of the plains. This basin, as well as the minor systems within it, is bounded by spurs from the great snowy range or transverse ridges descending from them. If we further examine the relations of the minor feeders of the three great constituents of the Jumna system, we see that, as a rule, they flow at right angles to their recipients, and that the affluents of these minor feeders obey a similar law. The ridge separating the Tons from the Jumna gives off feeders on the west to the Tons and on the east to the Jumna, at right angles to its direction. From the western slope the Dháragád, Binol, Shaula, and Manjgaon streams flow to the Tons, and from the eastern slope the Ralena, Kútni, and Silo seek the Jumna. Each of these minor feeders is separated from the other by lateral spurs, descending usually from some peak or knot of peaks, and all, as the veins on a leaf seek the midrib, flow towards the mid-depression and give it their moisture. The two great rivers that unite to form the Ganges are themselves the centres of subordinate systems. The Bhágirathi is divided from the Bhilang by a great ridge descending from the Gangotri group of peaks, whilst a second ridge having a similar origin separates the Bhilang from the Mandákini, an early affluent of the Alaknanda. The Bhágirathi unites with the Bhilang near Tírhi, and the two rivers drain a delta-shaped tract having its apex at Deoprayág. The Sáraswati and Dhauli, which form the head-waters of the Alaknanda, are separated from each other by a ridge of snowy peaks, and its more southern affluents, the Nandákini and the Pindar, are divided from each other by a great ridge descending from Trisúl. The entire basin of the Alaknanda to its junction with the Bhágirathi at Deoprayág is thus a great delta-shaped tract, cut up by the minor feeders into subordinate systems that are bounded by great ridges descending from the snowy range. Between Deoprayág and Hardwár, the Ganges receives from the east the Nayár and the Hinnal, and from the west the Súswa that drains the Dehra Dún. All unite within the Siwáliks to form the Ganges of the plains.

The Nayár.

We shall now take up the compact system of the Nayár in southern Garhwál, which at first sight would appear to be an exception to the general rules. We find that the boundary ridge that marks its extent is a continuation of the great ridge that, descending from the snowy peak of Nandakot, runs along the left bank of the Pindar to the head of the Lohba valley. Here, as already noticed, this ridge bifurcates; one branch proceeding in the normal direction along the left bank of the Alaknanda to Deoprayág, whilst the second branch passes south to Gujargarh and then west to the Ganges at Kharak. These two branches mark the axis of highest elevation in the tract through which they pass. Following the western branch, we have the Dubri peak, 9,862 feet: Dobri peak, 9,862 feet; Gandkhola, 7,553 feet; Devidatta, 7,034 feet; Kankwala, 6,651 feet; Gurdari, 5,893 feet; Jhangarh, 5,878 feet; and a peak about two miles from Deoprayág, 5,030 feet. Following the southern branch through Gujargarh, we find the second, Duda-ka-toli peak with an elevation of 10,180 feet above the level of the sea; Barmadúngi, 9,190 feet; Nandatopa, 8,086 feet; Khamek, 7,152 feet; Gujargarh, 7,969 feet; Khatti, 8,270 feet; Utain, 6,901 feet; Bukrari, 6,267 feet; and Naugarh, about a mile above Kharak, 6,065 feet. Close to the point of bifurcation, the boundary ridge sends a lateral spur southwards, that divides the basin of the Nayár into two parts, that drained by the western Nayár or Chhiphalghát river, and that drained by the eastern Nayár or Kainyúr stream. This great spur preserves the superior elevation of the boundary ridge, and is marked by the following peaks:—Barári, 8,499 feet; Bandani, 8,278 feet; Panjing, 8,810 feet; Devitank, 8,819 feet; Matikhál, 7,688 feet; and Chhatargah, 6,790 feet, when it is lost in the valley of the eastern Nayár near Kandui. Short ramifications from this spur or the boundary ridge itself determine the course of the minor feeders of the two great channels of the Nayár system. Thus a transverse ridge from Dubri, marked by the Tára-ka-kand (9,000 feet) and Banjkot (8,203 feet) peaks, divides the Chhiphalghát river near its source from its feeder at Paithání on the left bank, whilst other ridges from Gandkhola, Devidatta, and other peaks, separate the other feeders the one from the other. A similar rule obtains along the course of the eastern branch, and we thus see that there is no real difference in principle between the arrangement of the drainage system of this apparently abnormal minor basin and that of the other greater systems already noticed.

Western Rámganga.

In the system of the western Rámganga, however, we have an arrangement for which we find an analogue in that of the Bágmati in Nepál. As we have already seen, the basin of the Rámganga is in shape a great obtuse-angled triangle, with its apex towards the snowy range and its base towards the plains, thus filling up the gap between those systems that have their apices towards the plains and their bases towards the snowy range. Of its affluents, the Kosi alone has a considerable course within the hills, the remainder having their origin in or close above the elevated tract lying along the foot of the hills, and joining the Rámganga at some distance southwards in the plains. Here, although the main boundary ridges are still the spurs descending from the snowy range, the several streams do not unite within the outer range, but, like the Bágmati and its affluents, well beyond it in the plains. The Káli is known as the Yánkti near its source, as the Káli during the greater portion of its course through the hills, as the Chauka or Sárda in the Bhábar and Tarái, and as the Sarju and Ghogra in Oudh to its junction with the Ganges, to the south of the Gházipur district. The Káli basin is bounded on the west by that of the Ganges, and on the south-west by that of the western Rámganga. It receives from the west the Gori, Sarju, and Ladhiya, and from the east some small streams from Nepál, all of which unite within the hills to form the Sárda at Barmdeo. The Sarju is divided from its affluents, the eastern Rámganga, by a great meridional ridge, extending from their sources to their junction, whilst a second ridge, running in a south-easterly direction from the same group of peaks to Askot, separates the latter river from the Gori. The great Pancha-chuli range, running south-east from the line of water-parting, divides the basin of the Gori from that of the Dárma Yánkti, and a similar snowy range having a like origin separates the Dárma Yánkti from the Kuthi Yánkti. The great mass of peaks comprising Trisúl, Nanda Devi, and Nanda-kot thus send forth great boundary ridges from their entire southern face to the west between the Rámganga and Nandákini: to the south-west between the Nandákini and the Pindar, and between the Pindar and the Sarju; to the south between the Sarju and the eastern Rámganga; and to the south-east between the last river and the Gori. These indications are sufficient to mark the salient features of this portion of the Himálaya, and we reserve the details for the Gazetteer articles of this notice.

Káli.

The snowy range.

The mountain system lying between the snowy range and the plains may therefore be said to consist of an outer range parallel to the snowy range and connected with it at wide intervals where it meets the great ridges descending therefrom. These latter bound the river basins, and the ramifications from them determine the course of the minor feeders of each system. We have now to consider the snowy range itself, and in these provinces at least it is a well-marked feature, lying from ten to twenty miles to the south of the Indian water-parting. The line of snowy peaks seen from Naini Tál and Masúri all lie to the south of the passes by which travellers cross into Tibet. The route by Nilang in foreign Garhwál through the Jádh valley crosses north of the Jamnotri group; that by Mána in British Garhwál lies to the north of the Kedárnáth group; that by Milam in Kumaon behind the Nanda Devi group; and that by the Lanpiya-dhúra, also in Kumaon, behind the Panchachúli group. *The Jádh Ganga runs in a valley parallel to the snowy range and* the line of water-parting, at an elevation of 15,000 feet above the level of the sea, near its source at Sumla, but gradually falling to below 9,000 feet at its junction with the Bhágirathi, near Bhairon-gháti. The horizontal distance between these two points is a little over 17 miles, and the fall is therefore over 350 feet in a mile. The Vishnuganga or Sáraswati descends from the Mána Pass at 18,000 feet above the level of the sea to Vishnuprayág, a distance of some 35 miles, where it is little over 5,000 feet. Here we have an *average fall of about 370 feet in the mile. The increase in elevation* from the place where the river valleys enter the area of greatest elevation is equally marked in the valleys of the Dhauli, the Gori, and the Dárma river. Dhárchúla on the Káli, before the line of snowy peaks is reached, is only 2,750 feet above the level of the sea; whilst Golam La, to the north and above that line, and about 1,500 to 2,000 feet above the bed of the Káli, is 8,000 feet above the level of the sea. The bed of the Káli at Changru is 10,000 feet, and in the twenty-five miles between it and the Lanpiya-dhúra Pass the fall is over 8,000 feet, giving an average fall of 400 feet to the mile. These facts well illustrate the law that the river beds[1] to within a distance of ten miles in a direct line from the snowy peaks seldom exhibit a rise of more than four or five thousand feet; but when we cross the line on which the great peaks are situated, the ascent very rapidly increases, and a very few miles carries the river-bed up to an altitude of nine or ten thousand feet, thus showing that the sudden increase of height of the mountains along this line is not confined to the peaks alone, but is a general elevation of the whole surface.

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[1] See page 8.

Axis of highest elevation.

This sudden and steady rise in elevation when the line of snowy speaks is reached appears to be a well-marked feature of the entire Himálayan range. The snowy peaks, however, do not occur in a continuous ridge, but in masses separated the one from the other by deep depressions that form the line of drainage for all the surplus moisture of the tract between the snowy range and the line of water-parting to the north. These depressions are, so far as we know, a more distinctive feature of the Indian than of the Turkish slope of the Himálaya-Tibetan mass, a fact doubtless due to the greater rainfall received by the former. The influence of the monsoon on the southern slope is shown in its supporting a more dense and varied vegetation, and even on individual ranges and hills the southern exposure is similarly strongly marked in Kumaon. It is the ceaseless action of water that has furrowed out these valleys from the great mass, and naturally this has been accomplished on a greater scale and with more results along the southern slope that receives the full force of the periodical rains. The mass of peaks known as the Gangotri, Kedárnáth, and Badrináth groups, are separated from the next group to the east by the valley of the Sáraswati, and this group again from the Nanda Devi mass by the Dhauli river. The last is again divided from the Panchachúli group by the valley of the Gori, and the latter from the succeeding group by the Dárma valley. All these valleys are inhabited and cultivated during the summer and rains, and some of them are comparatively of considerable extent. The masses of snowy peaks are more like the terminal ends of huge spurs descending from the line of water-parting than a continuous ridge. They, however, occur in regular sequence along the entire line of the Himálaya, and, as seen from the plains, have the appearance of a connected chain. The following table, showing the principal peaks that occur throughout some eleven degrees of longitude, will give some idea of their number and importance.

Points on the Himálaya mountains arranged in order of longitude by Mr. Trelawny Saunders, from the records of the G. T. S.

Number.	Name of peak.	Latitude.	Longitude.	Altitude.
I.	Chumalari	27° 49′ 37″	89° 18′ 43″	23,944
II.	Gipmochi	27 16 23	88 56 37	14,518
III.	Pauhunri (Donkia)	27 56 52	88 53 5	23,186
IV	Chumunko (Chola)	27 27 28	88 49 38	17,325
V.	Black rock (Guaicam)	27 34 7	88 48 39	17,572
VI	Narsing	27 30 36	88 19 28	19,146
VII.	Pandim	27 31 44	88 15 35	22,017
VIII	Kanchanjinga	27 41 26	88 11 50	27,815
IX.	"	27 42 5	88 11 26	28,156
X	Kabru	27 36 26	88 9 15	24,015
XI.	Jannu	27 40 52	88 5 13	25,304
XII.	"	27 39 55	87 7 56	...
XIII	Sihsur	27 53 18	87 7 51	27.799
XIV.	Chamlang E.	27 46 27	87 1 21	24,020
XV	Mount Everest	27 59 12	86 58 6	29,002
XVI.	Chamlang W.	27 45 16	86 51 56	22,215
XVII	Sankosi	27 45 11	86 36 57	22,826
XVIII	"	27 52 46	86 31 57	21,987
XIX.	"	27 58 13	86 28 32	23,570
XX.	"	27 57 48	86 22 12	23,447
XXI.	"	27 57 24	86 9 8	19,560
XXII.	Jabjibiya	28 7 36	85 54 42	21,853
XXIII.	"	28 21 3	85 49 21	26,305
XXIV.	"	28 10 20	85 48 17	22,891
XXV	Dayabang	28 15 17	85 33 35	23,762
XXVI.	Akn	28 23 25	85 10 12	24,313
XXVII.	"	28 20 38	85 7 24	23,313
XXVIII.	Yassa	28 25 58	84 41 0	25,818
XXIX.	"	28 30 7	84 36 34	25,729
XXX.	"	28 32 55	84 36 9	26,680
XXXI.	"	28 39 39	84 21 56	...
XXXII.	"	28 39 21	84 20 32	...
XXXIII.	Barathor	28 29 18	84 13 56	22,947
XXXIV.	"	28 32 0	84 9 52	26,069
XXXV.	"	28 32 6	84 7 32	24,718
XXXVI.	Morshiadi	~~28 34 55~~	~~84 1 57~~	~~24,720~~
XXXVII.	"	28 29 37	83 59 22	22,961
XXXVIII.	"	28 29 48	83 59 20	22,986
XXXIX.	"	28 35 38	83 51 46	26,522
XL.	"	28 30 59	83 50 55	23,641
XLI.	"	28 39 11	83 46 22	22,471
XLII.	Dhaulagiri	28 41 43	83 32 9	26,826
XLIII.	Káráyam	28 45 39	83 25 52	25,456
XLIV.	"	28 45 8	83 25 12	25.299
XLV.	"	28 43 56	83 24 18	24,912
XLVI.	"	28 44 2	83 21 20	25,095
XLVII.	"	28 40 21	83 19 6	25,565
XLVIII.	"	28 43 49	83 15 0	24,181
XLIX.	"	28 44 47	83 11 18	23,779
L.	"	28 44 30	83 9 29	21,727
LI.	"	28 45 53	83 8 27	21,472
LII.	Chanbisi	28 49 33	82 39 33	19,415
LIII.	Api	29 59 7	80 56 22	...
LIV.	Padchachúli	30 12 51	80 28 9	22,673
LV.	"	30 15 12	80 25 5	21,471

Points on the Himálaya mountains arranged in order of longitude by Mr. Trelawny Saunders from the records of the G. T. S.—(concluded.)

Number.	Name of peak	Latitude.			Longitude.			Altitude.
LVI	Nandakot	30°	16′	51″	80°	6′	39″	22,538
LVII	Nanda Devi ...	30	21	58	80	2	21	24,447
LVIII.	Nanda Devi	30	22	31	80	0	50	25,661
LIX.	Do	30	22	35	80	0	16	25,587
LX.	East Trisúl	30	16	14	79	54	51	22,342
LXI.	Do.	30	30	56	79	54	31	23,092
LXII	West Trisúl	30	18	43	79	49	7	23,382
LXIII	Nandákna	30	22	9	79	45	40	19,916
LXIV.	Do.	30	20	56	79	45	36	20,722
LXV.	Do	30	20	57	79	45	35	20,773
LXVI.	Do .. .	30	11	6	79	44	53	22,093
LXVII	Kamet (Ibu Gamin) ..	30	55	13	79	38	4	25,373
LXVIII.	Nilakánta	30	43	52	79	26	56	21,661
LXIX.	Badrináth	30	44	46	79	19	20	23 210
LXX	Do.	30	43	22	79	17	52	22,514
LXXI	Do	30	46	41	79	16	58	22,347
LXXII	Kedárnáth	30	47	53	79	6	34	22,790
LXXIII.	Thalaságar	30	51	10	79	2	11	22,582
LXXIV.	Do.	30	51	11	79	2	13	22,628
LXXV.	Jaonli	30	51	18	78	53	53	21,672
LXXVI	Ras or Srikánta	30	57	25	78	50	50	20,149
LXXVII.	Bandarpunchh	31	0	12	78	35	45	20,758
LXXVIII	Jamnotri	31	0	25	78	34	6	20,038
LXXIX.	Swargarani	31	0	8	78	32	32	20,105

Tibetan plateau.

After crossing the line of water-parting which, as we have seen, lies at the valley heads to the north of the line of snowy peaks, we come upon the great Tibetan plateau which has a mean elevation of from 13,000 to 17,000 feet above the level of the sea. Puling on the plateau by the Nilang route is 13,800 feet, Chimkung on the Mána route to Totling is 15,700 feet, Chitung-dhár on the Unta Dhúra route to the Satlaj is 15,810 feet, and Buljuing near the head-waters of the Karnáli is 15,850 feet. Rabgyaling is 14,000; Gartokh, 14,240 feet; Tirthapuri, 14,820 feet; and lake Rákas Tál over 15,000 feet above the level of the sea. Captain H. Strachey has described[1] the Tibetan tableland lying between the Indian and Turkish water-partings "as the flat top of a great embankment exhibited in all its thickness in the scarp of the Indian Himálaya: the summit, though deeply corrugated with valleys and mountains in detail, being in its general relief laid out horizontally at a height little inferior to that of its southern scarp." Although the highest summits yet known and measured lie along the Indian slope, very lofty peaks have been seen in all parts of the interior, "and the passes which must be crossed to get from one Tibetan valley to another, even in the very central axis of drainage, generally equal those by which Tibet is reached from India:" so that, on the whole, Captain Strachey was of opinion that the medial depression is but faintly marked in the beds of the great rivers without much affecting the mean elevation of the mass. His description of the mountain system of that portion of Tibet lying to the north and west of Kumaon is the best that we possess, and will usefully conclude our brief review of the features of this portion of the Himálaya-Tibetan mass. "The mountains that compose the bulk of West Nári are not easily understood or defined. On ascending the highest passes we can seldom see anything but a contracted view of mountain tops on all sides, looking very like chaos: no general view of ranges under our feet is ever obtainable as the passes naturally select the ravine-heads and lowest points of the ridge which are not only flanked but often almost surrounded by the higher summits; and the valleys are commonly so steep and narrow, especially in the Rong country, that the view can hardly ever penetrate to an alluvial bottom and the sight of any inhabited place from a pass top is most unusual. When travelling along the bottoms of the valleys, we generally see nothing but a narrow tortuous passage between steep rocky walls, shutting out all extended view, and rather concealing than exhibiting the mountain ranges of which they form but the lowest outworks; consequently it is only by an extended series of observations and inferences, joined and assisted by maps, that any regular arrangement of these mountains can be distinctly established, and my account of them is liable to error in proportion to the defects of my own map. The general plan of the mountain system appears to me to consist of a series of parallel ranges running right across the breadth of the tableland in a direction so extremely oblique to the general extension of the whole as often to confound the one with the other, or to convert the transverse direction to a longitudinal one. The annexed figure may help to explain this. Short transverse necks connecting the main ranges in some parts, and cross fissures cutting through them in others, together with projecting spurs of a secondary order, will suffice to convert the supposed primary arrangements into all the existing varieties of valley and drainage.

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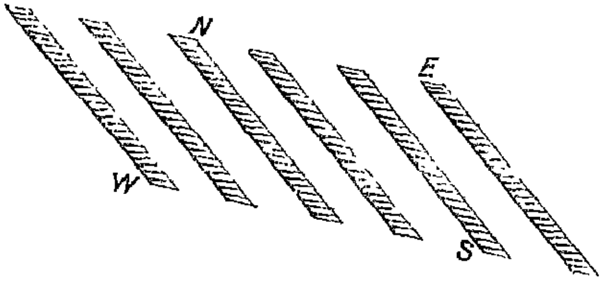
[1] On the physical geography of Western Tibet, London, 1854.



Such connecting necks, when above 18,000 feet, become more or less confounded with the main ranges, and, if not above 17,000 feet, often appear as low watersheds, just dividing the heads of two valleys lying in one line, but draining opposite ways. Secondary spurs also may be so high and so obliquely joined to the primary ranges as to make it difficult to distinguish between the two; and the cross fissures may sometimes admit a main river to pass through a main mountain mass, in which case the continuity of the range is often evidenced by the extreme narrowness of the rocky gorge or height steepness, and geological correspondence of its sides. Much of the Indian watershed seems to be formed in this way, the great snowy peaks lying mostly on the terminal butt-ends of the primary ranges, sometimes widened by lateral spurs, and the Tibetan passes crossing the low connecting links, whose alignment forms the main watershed, but not the main mountain crest."

Glaciers.

It seems strange that so late as the year 1847 the occurrence of glaciers in the Himálaya was considered a matter of doubt by the learned in Europe. There is now no fact more widely attested and more thoroughly established than the existence of glaciers at the head of almost every valley that descends from the ranges covered with perpetual snow. In size and importance they also fitly compare with those stupendous peaks around them that have placed the Himálaya in the foremost rank of all the mountains of the earth. Colonel Gordon gives us[1] illustrations and descriptions of the great glaciers met by the Yárkand Mission on the journey between Leh and the Kárakoram pass. He mentions the lower Kumdan glacier that comes from the high peaks to the north-west, and continues down the right bank of the stream for over two miles, "forming a perfect wall of ice, rising from the water about 120 feet, and showing a surface covered with countless pinnacles and points." The Remu glacier, also seen by Colonel Gordon, rises amongst peaks and ridges from 19,000 to 24,000 feet high. "It is about 21 miles in length and from one to one and three-quarters mile broad, terminating at an elevation of 15,800 feet above the level of the sea, with a width of about three miles of gigantic cliffs of ice fully 250 feet high." He adds :—"the glaciers of the western Himálaya are twice as extensive as those of the Alps, and are probably the largest in the world, or at all events larger than any others out of the polar regions. One in the Muztágh range is believed to be 34 miles long with fifteen distinct moraines ; while in its immediate vicinity is another, 31 miles in length, which may be said to join with it in making 65 miles of continuous ice." Other glaciers have been described by travellers in the ranges between Ladák and Garhwál. In the tract with which we are more immediately concerned we have glaciers at the head of the Jádh Ganga, the Bhágirathi, Vishnu Ganga, Dhauli, Kailganga, Sundardhúnga, Pindar, Kuphini, eastern Rám-ganga, Gori, and Dárma Yánkti. Lieutenant Weller[1] in his visit to the source of the Gori near Milam, describes that river as coming "out in a small but impetuous stream at the foot of apparently a mass of dirt and gravel some 300 feet high, shaped like a halfmoon. This is in reality a mass of dark-coloured (bottle-green) ice, extending westward to a great distance, and covered with stones and fragments of rock which in fact form a succession of small hills." Here and there were circular and irregularly shaped craters (as it were) from 50 to 500 feet in diameter at top, and some of them 150 feet deep, and higher up these gave place to narrow fissures. This glacier is between seven and eight miles long, and terminates at an elevation of 11,600 feet above the sea. The glacier of the Pindar in Kumaon is the one, however, regarding which we have the most complete informatiom, and we shall confine ourselves, therefore, to its description in detail.

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[1] Roof of the World, 17.

[1] J., A. S., Ben, XI., 1106.

Glacier of the Pindar.

The Pindar river[1] is an affluent of the Alaknanda, and has its rise in a glacier to the west of the Nandakot peak and its valley, where the glacier ends, is about a mile across between the precipitous mountains that bound it. From the foot of the rocks on either side the bottom of the valley slopes inwards with a moderate inclination, leaving in the middle a hollow about 300 yards wide and 250 feet deep, with very steep banks, at the bottom of which flows the river. This comparatively level space between the precipices on either side and the river bed is observable for a mile or more below the end of the glacier, though much cut up by watercourses. The glacier occupies about two-thirds of the whole breadth of the head of this valley, leaving between itself and the cliffs on the east an open grassy slope, which extends along the foot of the moraine for upwards of a mile and a half above the source of the river, and which seems to be a continuation of the level space before mentioned. The first appearance of the glacier is thus described :—"It seems to be a vast rounded mass of rocks and ground utterly devoid of any sign of vegetation, standing up out of a grassy valley. From the foot of its nearer extremity the river, even here unfordable, rushes in a turbid torrent out of a sort of cave ; the top of which is but a few feet above the surface of the water (May). The end, immediately over the source of the river, is very steep and of a dull black colour. It is considerably fissured, the rents appearing to arise from the lower parts, tearing themselves from the upper by their own weight. On a closer examination this abrupt end proves to be a surface of ice covered with sand and gravel and curiously striped by the channel made by the water that runs down it as it melts. Behind this, the glacier rises less steeply, like a bare gravel hill, to its full height, which is probably about 500 feet above the water of the river when it leaves the cave. In some places, however, are seen great fissures both vertical and horizontal, the latter evidently made by the separation of regularly stratified layers."

Feeders of the glacier.

The glacier is formed by the meeting of two ice streams from gorges, one coming from the north-west and the other nearly from the east, and which

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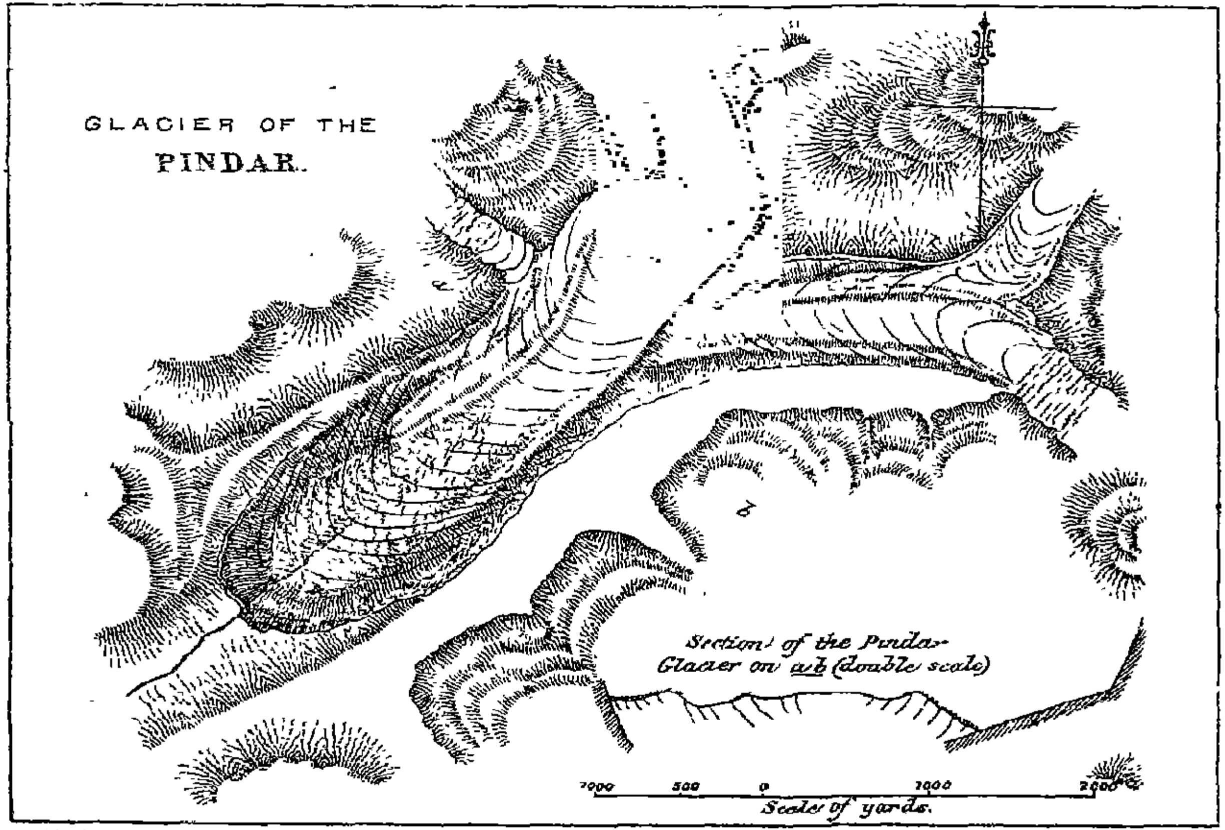
[1] From "A description of the glaciers of the Pindar and Kuphini rivers in the Kumaon Himálaya," by Lieutenant R. Strachey, Ben. Eng., J., A S B, XVI, 794, and "Note on the motion of the glacier of the Pindar in Kumaon" by the same. *Ibid.*, XVII., ii., 203, and given as nearly as possible in the writer's words as the only scientific examination of these glaciers that we possess.

GLACIER OF THE PINDAR.



J. A. S. Beng. XVI. 796.

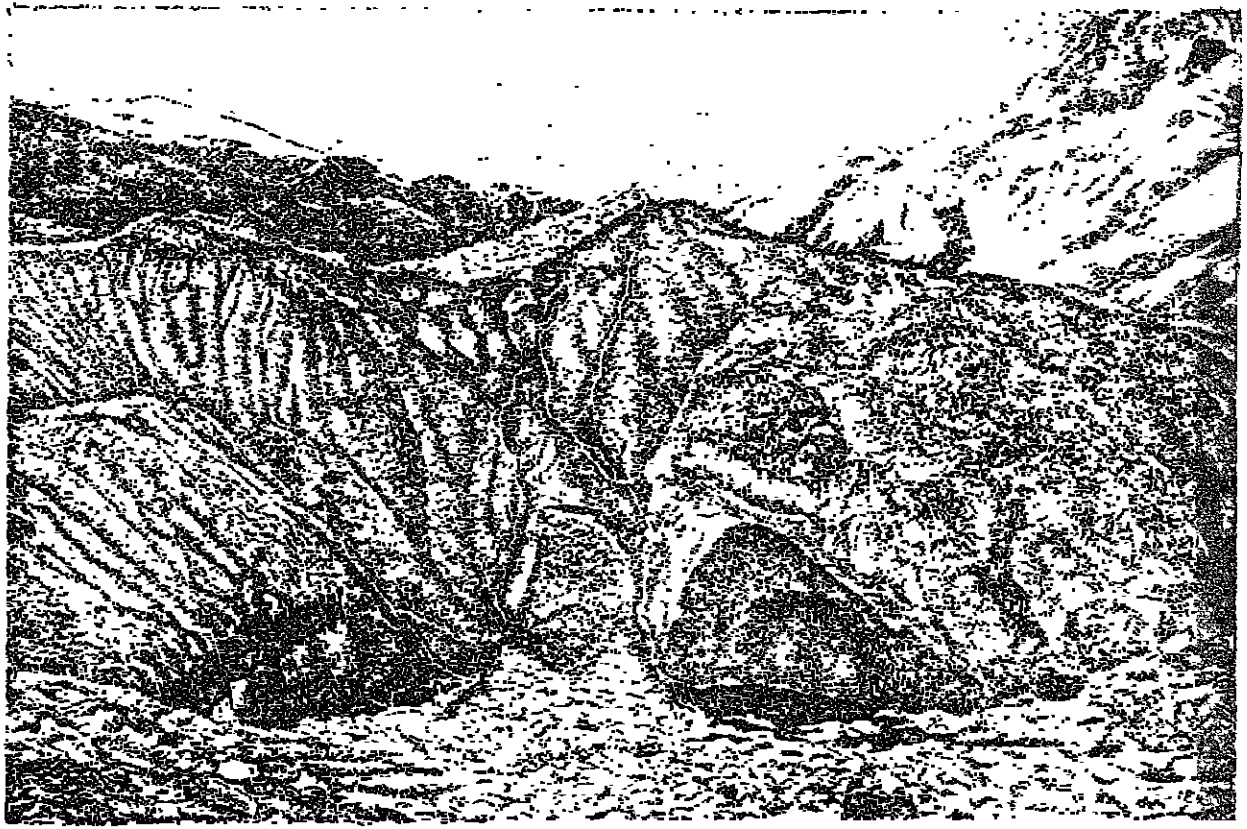
meet about two miles above the source of the river, as shown in the accompanying sketch.

The feeder from the north-west is larger than that from the east, and its surface is at a considerably higher level for some hundred yards below their first junction. It descends with a great inclination, entirely filling the gorge, down which it comes in a cascade of ice. It assumes the general appearance of a confused mass of irregular steps, which are again broken up transversely into peaks of every shape. The west side of this cascade continues nearly in its original direction after having passed the point below which the glacier bends sharply to the south-west, and in this way completely crosses the glacier. The steps in which it falls, however, also gradually change their direction so as to remain nearly perpendicular to the general current of ice. The transition to the regular level ice is very sudden, and begins much higher up on the west than on the east side. Near the foot of this ice-fall the steps were observed to have their tops considerably overhanging. A small tributary, also descending in cliffs of ice, joins the main glacier from a ravine on the east, not far above where it takes the sudden bend. The feeder from the east is formed by the union of two smaller glaciers, one from the north-east and the other from the south-east, which is the larger of the two. The north-eastern tributary appeared to have no very steep inclination, but was considerably broken up at its junction with the other. Another small glacier joins the main one from the north-west, a short distance below the point where it bends southwards. Its inclination is very great, but it perfectly maintains its continuity of structure to the bottom.

Moraines.

The lateral moraine of the west side of the northern branch of the glacier is first seen near the bend, where it shows itself as a black band along the edge of the ice which in other parts of the fall is quite white. The moraine is small between the bend and the tributary glacier below it, but very rapidly increases, and in its lower parts is a chaos of desolation. This great addition to the size of the moraine is owing to the quantity of *débris* brought down by the small glacier. The ice below the junction is much broken up by crevasses, and rocks and gravel from the moraines on both sides of the tributary glacier are scattered over the space between them, and the moraines at first sight seem to lose their distinct form. Although there is no clear ice between the moraine that originates on the east of the tributary and the west side of the glacier, the identity of that moraine is sufficiently marked by its colour and by the regular rise above the general surface of the glacier of its top, which remains tolerably even for some way down, being beyond the limit of the disturbance caused by the crevasses along the edge of the glacier. About half way down to the lower end of the glacier, however, the full action of these crevasses reaches the whole of the moraine, and it is scattered or lost sight of in the general confusion of surface. An epoch of peculiar destructiveness to the mountains is marked in one part of this moraine by the accumulation of huge masses of rock from 20 to 30 feet square and as much as 15 feet high, and the stone found on it are generally larger than those on any of the other moraines. The true west lateral moraine, below the tributary glacier, is not very large, nor is its top much elevated above the bottom of the valley, excepting quite at its end.

The lateral moraine of the south-eastern side of the glacier is very large. Its top rises, on an average, probably 250 feet above the bottom of the valley. Along its foot runs a stream, gradually increasing in size, that collects the open drainage of the outer slopes of the moraine. The lower part of this slope is a mass of loose stones and earthy gravel which rolls down from above, as the face of the ice which is visible in the upper fifty or sixty feet of the slope melts and recedes, a process that is constantly going on. On the inner side the slope of the moraine is thirty or forty feet above the level of the clear ice of the glacier. The upper part of the moraine comes down nearly straight from the point where it meets the foot of the north moraine of the east glacier. The north branch glacier being considerably higher than the eastern, the moraine slopes down from the bed of the former to that of the latter, forming a deep angular depression where they meet, that gradually diminishes in depth up to the top of this glacier, which is here entirely covered with *débris*, the moraines of its two sides being scattered all over it for some distance above its union with the north or main branch. The resulting appearance is that the northern branch runs over the eastern, or that the latter runs into the former and is absorbed by it. The eastern tributary brings



From a photograph by [illegible]

down moraines that spread over the whole of its breadth at its extremity. Besides these lateral moraines there is a medial one that is first seen as a dirty stripe along the ice cliffs of the fall at the head of the north glacier. As it comes down the level ice it gradually begins to assume the decided appearance of a moraine, and increasing by degrees at last becomes very large. It continues in a well-defined form for some short distance beyond where the western moraine is dispersed, but there it also is scattered over the ice, and the two become blended together, and ultimately extend to meet the *débris*, which is similarly dispersed by the eastern moraine from the opposite site of the glacier. The whole of the moraines, in the middle of the length of the glacier where it is most regular, are very considerably raised above the general surface of the ice, which in some parts may be as much as one hundred feet below the tops of the western and medial moraines. It would appear that this great elevation is not so much due to the accumulation of *débris* as to the protection afforded by the superincumbent rubbish to the ice below which prevents its being melted. The clear ice beyond the moraine is constantly depressed where exposed, and on the very tops of the moraines pure ice was often seen hardly covered by stones. The protection afforded by the lateral moraines raises the sides of the glacier so much that a very considerable hollow is caused in its middle, which is a striking feature in the first appearance of its lower extremity.

Crevasses, glacier tables.

The ice of which the glacier is composed is perfectly pure and clear, but where seen in considerable masses, stripes of a darker and lighter bluish green are distinctly visible. It is composed of bands of ice containing small air bubbles, alternating with others quite free from them. In many places the surface presents a striated appearance, arising from the different degrees of compactness of these differently coloured bands and their consequently different rates of melting. The direction of these coloured views as seen in crevasses showed a dip inwards or towards the longitudinal axis and a dip upwards or towards the origin of the glacier in every part, the stratification being more perpendicular towards the head and more nearly horizontal in the lower parts. The direction of the strata in place was also very clearly marked in many parts of the ice, and was placed in curves, having their branches nearly parallel to the sides of the glacier and their apices directed downwards, the curvature in the centre not being at all sudden. No dirt bands were observed. The crevasses were neither very numerous nor very formidable. They are developed across the direction of the glacier's length on both of its sides, commencing from the small tributary on the west side and from the union of the eastern glacier on the other, and continuing almost to the end, those on the west side being, perhaps, the larger. They are generally wider towards the edges of the glacier, closing up as they approach the centre. They are nearly vertical, and are directed from the sides upwards or towards the head of the glacier, those on the west bearing nearly east and west, and those on the east bearing nearly north and south, thus forming angles of about 45° with the axis of the glacier. Many pools of water (*baignoires*) were seen on the surface of the ice; some of the largest were said by the guides, who are in the habit of visiting the glacier, to be found in the same place every year. The clean surface of the ice everywhere assumes a more or less undulating appearance from the action of the water that drains from it as it melts and the small streams, into which the drainage collects, end by falling into some of the crevasses. The remains of the last winter's snow was hardly perceptible on any part of the glacier. The occurrence of stones standing up on bases of ice (glacier tables) above the general surface of the glacier is common, but those seen were small. The rocks below the bend in the north-western glacier were covered with grooves or scratches, sloping in about the same direction as the surface of the ice at the spot. These grooves extend to twenty or thirty feet above the present level of the glacier. Almost in every place a space was left between the rock and ice, the latter appearing to shrink from contact with the former, due doubtless to the heat of the rock melting the ice.

Glacier of the Kuphini.

The Kuphini river, that rises on the side of the Nanda-kot peak, opposite to the Pindar river, has also its source in a glacier. Both rivers unite at Dwáli, about eight miles from the end of the Pindar glacier and about six miles from the end of that of the Kuphini. General Strachey examined the Kuphini glacier also, and describes the valley for a mile or two below the end of the glacier as having very much the same general character as that of the Pindar, but somewhat more rugged and desolate in appearance. The glacier commences about two miles above the source of the river and fills the whole breadth of the valley, which is about three-quarters of a mile broad in its upper part. The glacier begins in a precipitous fall of ice some sixty or seventy feet high, which, however, still exhibits the ribbon-like structure. From the foot of the fall the surface was very even, though the slope was still considerable. The main glacier of the Kuphini is joined by two small tributaries on the east and by one on the west, all of which are highly inclined and bring down considerable quantities of *débris*. The *moraines are confined to the sides of the glacier, though many small* stones are scattered over every part of the ice. As was observed on the Pindar, the protection given by the lateral moraines to the underlying ice leads to the promotion of a medial depression in the glacier at its end. The crevasses here, too, are most strongly marked near the sides and are inclined at an angle of about 45° from the longitudinal axis downwards. The structure of the ice was in all respects similar to that found on the Pindar. On the interesting question of the extension of glaciers at a remote period the inquiries of General Strachey give no precise information. He, however, considers that "some very decided change in the state of things is certainly indicated by the long plateaus before mentioned running for a mile or two below the present terminations of both glaciers nearly parallel to the rivers, but several hundred feet above them." He considers it "impossible that these level banks above the rivers have been caused by deposits from the ravines in the sides of the valleys, for such deposits would have had very irregular surfaces, and indeed their present effect in destroying the regularity of the plateaus is everywhere visible. Had the same appearance been noticed in any other part of the river's course, it would at once have been attributed to the action of water at some former period, and it would have been supposed that the bed had afterwards been excavated to its present depth. If this was the case, the glaciers which the plateau was forming must either have terminated considerably higher up the valleys or have stood altogether at a much higher level. In either of these ways the water could have been delivered at a level sufficiently high to form the plateau. But it may admit of doubt whether the quantity of water in the rivers, as they are at present, is sufficient to account for such an extent of level deposit or for such a depth of erosion of their beds; for at this great elevation they are not subject to those violent floods that occur lower down, and for nearly half the year too they are inert. The only other way of accounting for the appearance is that it has been occasioned by an extension of the glacier, and that the level top of the plateau shows the limit to which the tops of the moraines reached, as the glacier gradually receded." We have referred on a previous page[1] to the existence of evidence of glacial action far below the present limits of glaciers, and to those who wish to pursue the subject further we commend the records of the Geological Survey and the summary[2] in the recently published 'Manual of the Geology of India.'

Motion of the Pindar glacier.

General Strachey has rendered us another important service in his observations on the motion of the Pindari glacier recorded in May, 1818. His procedure is thus stated. About 200 yards below the small tributary that enters the main glacier from the north-west a moraine was found heaped up against an almost perpendicular wall of rock, and sufficiently high to command a view of the greater part of the surface of the glacier along the line on which observations were to be made. This line, which is nearly perpendicular to the general direction of the glacier, was marked by two crosses painted white, one on the rock in contact with the old moraine and one on a cliff on the opposite side of the valley. A stake was driven into the moraine at its highest point, close to the rock, on the line between the two crosses, and a theodolite was set up over it. Five other marks were also made on the glacier at intervals along the same line by fixing stakes in holes driven in the ice with a jumper. These marks, which were all carefully placed on the exact line between the crosses by means of the theodolite, were completed at about 0h. 30m. P. M. on the 21st May. On the following day the theodolite was again set up on the same place as before, and being properly adjusted, the cross-wires of the telescope were directed to the cross on the cliff on the opposite side of the glacier. A stick was then set up near the first of the five marks that had been made the

[2] Pp. lxx., 372, 373 586, 689,

previous day, and was, by means of signals, moved up or down the glacier, till it appeared to coincide exactly with the cross-wires of the telescope, and consequently to be exactly on the line between the two crosses painted on the cliffs. The distance between the centre of the stick and that of the fixed mark was then measured, which evidently showed the downward progress of the ice at that point of the glacier, since the marks were made the day before. The same procedure was followed at each of the marks. The results were as follows:—

Time of observation.	*Distances of fixed marks from standard line.*				
	On the west moraine.	On the medial moraine.	At east foot of medial moraine.	Near the middle of the clear ice.	On the eastern moraine.
h. m.	ft. in	ft. in.	ft. in.	ft. in.	ft. in.
21st May 0 30 p. m.	...	...	...	...	...
22nd „ 1 15 p. m.	0 5½	1 0¼	1 0	1 0¼	0 6¾
25th „ 8 45 a. m.	1 9½	2 9¼	2 11¾	3 1	1 6½

The motion in 24 hours of the several marks will also be found to be—

Date.	*Mean motion (in inches) of ice in 24 hours.*					
	On the west moraine.	On the medial moraine.	At east foot of medial moraine.	Near the middle of the clear ice.	On the east moraine.	Approximate mean temperature.
21st to 22nd May .	5·3	11·9	11·6	11·9	6·5	43°F.
22nd „ 25th „ ...	5·7	7·6	8·1	8·8	3·8	38°F.
General mean ...	5·5	9·7	10·0	10·3	5·1	...

The progress of the lower extremity of the glacier was likewise approximately measured by observing the apparent angular motion of a pole fixed on the top of the eastern moraine, and of a conspicuous rock lying not far from the middle of the glacier. The results of these observations were—

Date.	*Mean motion (in inches) of ice in 24 hours.*	
	On the moraine	Near middle of the glacier.
19th to 20th May ..	3·0	.
20th „ 23rd „	6·2	8·1
23rd „ 25th „	5·3	10·8
General mean	4·8	9·4

A comparison of the motion of the upper and lower parts of the glacier gave on the lateral moraines 4·8 inches as the mean motion of the ice in 24 hours in the lower part of the glacier, and 5·3 inches in the upper part, and in the middle of the glacier 9·4 inches as the mean motion for the lower part, and 10 inches for the upper part of the glacier. The elevation of the foot of the glacier at the source of the Pindar is 11,929 feet, and of the theodolite station, where these observations were made, was 12,946 feet above the sea.

Snow-line.

We have made mention of the snow-line or limit of perpetual snow,[1] which has, at times, given rise to considerable discussion. The height at which precipitations of vapour fall to the earth's surface as snow varies with the temperature of each particular place, and with the annual or even diurnal oscillations of the temperature. In Bhután and Sikkim the ordinary winter limit of snow is about 6,000 feet, and it is rare, says Dr. Hooker, for even three inches to remain on the ground as many days at 7,000 feet.[2] According to General Strachey, the height at which snow is certain to fall in Kumaon is about 6,500 feet, and at an elevation of 5,000 feet it will not fail more than one year out of ten. The lowest level to which sporadic falls of snow are here known to descend is about 2,500 feet, of which there are two authentic instances on record since the British occupation, the first in 1817 and the second in 1847. In the valley of Kashmír, at an elevation of 5,500 feet, the snow falls every year,[3] and further west as low as 4,000 feet, whilst at least one fall of snow is recorded at Peshawar, which has an elevation of only 1,250 feet above the level of the sea.[1] Campaigning experiences during the late war show that the winter snows descend to a very low elevation in the valley of the Kábul river and at Kandahár. If we follow the lower boundary of the winter snow on a mountain as it melts with the advance of summer, we at length ascend to a height at which the summer influence is insufficient to entirely melt the snow, and from which, as the season advances towards winter, we have gradually to descend in order to follow the line of snow. The line to which the snow recedes, and from which it again advances in one complete revolution of the seasons, is called the snow-line. The snow above that line is called perpetual snow, not as observed by Professor Forbes, that the continuance of snow at any spot implies that it never melts there, but only that some always remains unmelted.

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[1] These observations on the snow-line are based on the article in J., A. S., Ben., XVIII, i, 287, entitled, "On the snow-line in the Himálaya," by Lieutenant R. Strachey, Engineers, on notes placed at my disposal by the same writer, and on the works of recent travellers.

[2] Hooker, Quar. J., Hort. Soc., VII., 111, Griffith Post. Papers, I, 236.

[3] Moorcroft, II., 107.

Observations in the eastern Himálaya.

According to our best authorities, the height of the snow-line on the most southern exposures of the Himálayan slope that carry perpetual snow ranges from 15,000 to 16,000 feet all along that part of the chain that lies between Sikkim and the Indus, whilst to the north towards Tibet it has a considerably higher elevation. Before proceeding further we may observe, with General Strachey, that "all estimates of the snow-line are, in the very nature of things, subject to no little uncertainty; for, independently of the variations of the seasons from year to year there are naturally considerable differences in the level at which the snow lies on steep or slight slopes and on north or south exposures, between the latter of which a difference of as much as a thousand feet may at times be observed. Besides this, too, there is some practical difficulty in the actual observation of the snow-line, for the process of judging by the eye whether the snow upon one's path and still more on contiguous mountain sides begins to exceed the bare spaces is neither easy nor susceptible of much precision. Hence the errors and uncertainty to be looked for in all our conclusions must be considerable, amounting no doubt to several hundred[2] feet." Dr. Hooker estimated the height of the snow-line on the most southern spurs of the snowy mountains in Sikkim to be at about 15,500

[1] Bom. Geog Jour., X, 39.

[2] Captain H. Strachey, J. R. G. S., XXIII. 69.

feet.[1] Of the peaks covered by perpetual snow, the elevation of which is noted in Dr. Hooker's map, Chola, on the boundary between Sikkim and Bhután, is the lowest, (17,300 feet), and at the same time the most southern and the Chola Pass immediately to the south of the peak, and rising to 14,900 feet, he found to be free from snow at the beginning of November. Somewhat further to the north, near Youngbong, the lower limit of perpetual snow was directly measured in September and found to be nearly 16,000 feet. To the west of Kanchanjinga in eastern Nepál, the south-eastern descent from the Kambache pass was found to be free from snow, a little from the summit, at the beginning of December, and on the northern approach the snow was supposed to become perpetual at about 15,000 feet, though the fresh falls of the previous October forced Dr. Hooker to be in some measure guided by the people of the country in this estimate. On the ascent to the Wallanchun or Wallangsum pass the snow-line was again estimated, though under similar circumstances of doubt, to be at 15,000 feet. The Pandit crossing the same pass, his Tiptala, on the 16th August, 1871, found it covered with snow,[2] and Dr. Hooker on December[3] 31st, 1818, crossed "with snow on both sides up to the shoulder."

Observations in Kumaon.

The following are the results of trigonometrical measurements of the elevation of the inferior edge of the snow observed on spurs of the Trisúl and Nanda Devi groups of peaks, made by General R. Strachey before the winter snow had commenced in 1841 :—

Point observed.	*Height of snow-line.*		Mean.	Remarks.
	On south exposure.	On west exposure.		
No 1 ...	16,705	15,892	16,298	These heights were calculated from observations made with the theodolite at Almora and Binsar. The distance of these two places, which served as a base, was obtained by measurement from a map of points fixed by the G. T. Survey. The elevations of the two places were taken from Captain Webb's trigonometrical survey.
2 ...	17,007	...	...	
3 ..	17,205	11,898	16,051	
4 ..	15,317	...	...	
Mean . .	15,566	15,395	16,174 15,980	

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[1] Himálayan Journals.

[2] Reports, 1871, p 1 the name appears to be derived from the Wallungsumgola to the south the pass itself has an elevation of 15,618 feet.

[3] J., A. S., Ben., XVIII., i, 524.

The points 1, 2 and 3 are on ridges that run prominently out in a south-westerly direction from the great peaks of Trisúl G. (G. T. S.) same as Webb's No. XI. and H. (G. T. S.), same as Webb's No. XII. The dip of the strata being to the north-east, the faces exposed to view from the south are for the most part very abrupt and snow never accumulates on them to any great extent. This will explain the difference between the heights at which snow was observed on the southern and western exposures, the ground having been less steep on the latter and better able to retain the snow; but in these places it was in very small quantities, and had probably fallen lately, so that its height may probably indicate the elevation below which the light autumnal falls were incapable of lying rather than the inferior edge of the perpetual snow. It is further to be understood that below this level of 15,000 feet the mountains were absolutely free from snow, excepting those isolated patches that are to be seen in ravines or at the head of glaciers, which do not affect such calculations as these. The point No. 4 was selected as being in a much more retired position than the others, and is situated not far from the head of the Pindar river, between the peaks of Nanda Devi, I. (G. T. S.), same as No. XIV. of Webb, and of Trisúl H. (G. T. S.) It was quite free from snow at 15,300 feet. On the whole, therefore, General Strachey is inclined to consider that 16,000 feet may be given as a close approximation to the maximum height to which the snow recedes every year on the most southern and external ranges in Kumaon.

Bisahr.

This result appears to accord well with what has been observed by Dr. Gerard in a visit made by him to the Shatúl pass in the Bisahr range expressly for the purpose of determining the height of the snow-line.[1] He reached the pass, the elevation of which is 15,000 feet, on the 9th of August, 1822, and remained there till the 15th of that month. The southern slope of the range was generally free from snow, and he says that it is sometimes left without any whatever. On the top of the pass there was no snow, but on the northern slope of the mountain it lay as far down as 14,000 feet. On his arrival rain was falling, and out of the four days he was there, it rained and snowed for the greater part of three. The fresh snow that fell did not lie below 16,000 feet, and some of the more precipitous rocks remained clear even up to 17,000 feet. Dr. Gerard concludes that 15,000 feet is about the height of the snow-line on this range, but it will be seen that Dr. Gerard was there rather early in the year, and General Strachey, from what he heard from others who crossed the range later in the season, thinks that 15,500 feet will probably be a better estimate, even if it should not be carried still higher. At the beginning of the month of July, Captain Gerard found heavy snow on the northern face of this Bisahr range at about 15,000 feet, and the Kunlia pass, the elevation of which he states to be 17,000 feet appears never to be free from snow[1] Dr. Thomson[2] agrees that the estimate formerly made by General Strachey of 15,500 feet, which his subsequent researches led him to believe was a little too low for Kumaon, is as nearly as possible correct for the Bisahr range. He adds—"Captain Herbert, in his geological report, had fixed upon 15,000 feet, which is a little too low even in the district of Bisahr, to which his estimate, I believe, refers. In the trans-Satlaj Himálaya, from the diminished amount of summer cloudy weather, the snow-level is probably a little higher." The Chamba range and the Pir Panjal, south of Kashmir, both of which rise immediately from the low external sandstone hills, just enter, he tells us, the region of perpetual snow. The highest peaks of the former are about 16,700 feet, and its mean height about 15,000 feet above the sea, and *its snow-line will consequently be not far from 16,000 feet.* Major A. Cunningham also places the snow-line on the most southern ranges of the Himálaya to the west of the Ganges at about 16,000 feet.[3]

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[1] Tours I, 289-347.

Across the snowy range.

When, however, we advance into the interior of the chain, after having once passed over any range of sufficient height to come within the limits of perpetual snow, we invariably find that there is less snow on all such ridges of similar altitudes so that when we arrive at the Indian watershed, the snow-line has risen to about 18,500 feet, and on the summit of the tableland it reaches to an elevation of 20,000 feet. Dr. Hooker observed this phenomenon in Sikkim, and bears testimony to the gradual rise of the snow line as we enter among the peaks covered with perpetual snow. Near Zemu, twenty miles north-east from Kanchanjinga, he found little snow on south exposures at the beginning of July. A little further in, above Phalung, in the middle of the same month, the snow-line was supposed to be about 16,500 feet, and at the end of the month many plants were obtained at 17,000 feet. Another ascent in the same vicinity about the same time did not carry our traveller to perpetual snow at 16,800 feet. On the flanks of the Kanchan-jhao broad summits were seen quite bare of snow at 18,000 feet. Dr. Campbell[1] who accompanied Dr. Hooker on his return journey in September, notes that vegetation ceased at the foot of the Dankia pass at 18,000 feet, and there was no trace of it within 500 feet of the summit on either side. There was no snow on the road as he ascended the north face nor as he descended the south face, but it lay in patches amongst the rocks all the way on both sides. On the mountain to the west of the pass snow lay deep in hollow places, but these may have had glacial ice in them though the surface of the snow was then smooth. The line of snow would here be 19,800 feet, and further north in Tibet it rose to 20,000 feet. Bhorutso, on the 18th October, had not a particle of snow on it at 18 or 18,500 feet, whilst in the Lachung valley in Sikkim to the south snow was lying at about 15,000 feet. Dr. Campbell adds:—"South of the Himálaya, the quantity of snow that falls is very much greater than in Tibet, and from the greater moisture of the air and cloudiness of the sky, it is not carried off with the rapidity of evaporation which obtains in Tibet, where you do not find even a rill of water from the melting snow. Besides in Tibet the snow falls in light, feathery skiffs, and not in flakes. I believe that the lowest snow-line we saw on the mountains to the north of us in Tibet must have been upwards of 22,000 feet. On the Kambajang range, which, comparing them with Bhorutso, must be 20,000 feet at least, there was not a particle of snow."

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[1] *Ibid*, II., 71.

[2] Travels, p 487.

[3] Ladák, pp. 73-77.

Kumaon.

We have the results of General Strachey's experience for Kumaon and Garhwál. Towards the end of August, 1848, he crossed the Barjikáng pass leading from Rálam to Juhár on a subordinate ridge between the Nandakot and Panchachúli peaks. Although this pass has an elevation of about 15,400 feet, not a vestige of snow was met with on the ascent from the south-east, and only a very small patch remained on the north-western face, and indeed, in no considerable quantity, up to 17,000 feet. The vegetation on the very summit of the pass was far from scanty, though it had already begun to break up into tufts, and had lost the character of continuity it had maintained to within 500 or 600 feet of the top; but many species of flowering plants, all evidently flourishing in a congenial climate, showed that the limits of vegetation and regions of perpetual snow were still far distant. This place is within ten to fifteen miles of the most southern border of perpetual snow. The Unta-dhúra pass has an elevation of about 17,300 feet, and lies to the north of the great peaks nearly at the crest of the watershed. There was no snow along the southern ascent to this pass, at the top of which General Strachey arrived in September, 1848, in a little drizzle of rain that at last turned into snow. The ground was quite free from snow, being worked up into a deep black mud by the feet of the cattle that had crossed it. There was, however, on the north side of the pass an accumulation of snow some little way down, extending perhaps 200 feet, apparently the effect of the drift through the gap in which the pass lies. No snow was seen on the hills on either side within some few hundred feet, and the snow-line was certainly above 18,000 feet. Vegetation reached to within 300 or 400 feet of the summit.

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[1] J., A. S., Ben., XXV., 565.

Garhwál.

The Chor-hoti pass (18,000 feet) and the Marshak pass, (18,400 feet), both to the north of Níti, have a position relative to the great snowy masses nearly similar to Unta-dhúra. The Marshak pass was crossed in July by General Strachey, a time rather too early to judge fairly of the snow-line, which is also obscured by the presence of a glacier that fills up the valley by which the pass is approached.[1] On the Chor-hoti pass in September there was not a vestige of snow on any part of the southern face of the ridge that the route crosses, but on the north face was a patch that was plainly perpetual, descending some hundred feet to a glacier which was connected with that just mentioned to have been crossed at Marshak or Balchak. The snow-line was, therefore, here no doubt near 18,500 feet. The Kyungar and

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[1] This expedition is apparently referred to in J., A. S., Ben., XIX., 79.

Balchha passes, each about 17,500 feet in elevation, and both lying to the north of the Unta-dhúra pass, were equally free from snow on their southern faces in September, small quantities only being found on the northern aspects. The highest points on the ridge, over which the latter of these passes leads, only just exceed 18,000 feet in elevation, and in fact it does not come within the limits of perpetual snow, nor does it appear snowy when viewed from the Tibetan plain to the north of it. The vegetation on all these passes reaches to about 17,500 feet. Lieutenant Weller visited the Balchha pass[1] on the 1st June, 1842, and found "towards the top of the ascent a tolerable quantity of snow, but in detached portions." The Lákhar pass also, to the north of Unta-dhúra, was crossed by General Strachey in September. It has an elevation of about 18,200 feet, and was found free from snow on both sides, as well as the Jainti ridge some 200 feet higher. This latter is, however, a somewhat detached spur, and the snow-line was manifestly near, for unbroken snow could be seen in more sheltered places considerably below this elevation. General Strachey thinks that, on the whole, 18,500 feet may be considered a fair average height of the snow-line in this locality. Lieutenant Weller crossed the Unta-dhúra pass at the end of May, and found more soil than snow visible, whilst snow was scattered thinly on either side, but the northern slope presented one unbroken sheet of steep snow.[2] In September (28th) Captain Manson found the last ascent to this pass quite free from snow. A detached peak, Lanjar, a little to the north of the Níti pass, and having an elevation of 18,400 feet, was found by General Strachey nearly quite free of snow having only a patch lying in a ravine on the north side of the hill. Two other peaks near the Balchha pass, seen from Lanjar, having an altitude of 18,100 and 18,200 feet respectively, were also quite free from snow, so far as could be ascertained at the distance. Mr. J. H. Batten, who visited the Níti Pass in 1837, found it free from snow, of which the first heavy fall did not occur till the 11th of October.[3]

In the more western part of the mountains the authority of the Gerards, of Dr. Thomson and of Major A. Cunningham coincide in fixing the snow-line at much about the same level as that just assigned to Kumaon. Captain J. D. Cunningham also accepts

[1] J., A. S., Ben., XII., 97. [2] *Ibid.*, XII., 87. [3] *Ibid.*, VII., 810.

Kunaor.

the results of General Strachey's observations. In upper Kunaor Captain Gerard[1] found a little snow on either side of the Kyubrang pass (18,300 feet) in July, but none on its summit, and the summits in the neighbourhood, though attaining a height of 18,000 or 19,000 feet, were only just tipped with snow.[1] The Gangtang pass, also 18,300 feet and lying a little farther to the west, was snowy for the last few hundred feet at the end of the same month. The Kyubrang pass is on the Indian waterparting, and the Gangtang pass a little within it, but both the observations were made before the snow-line had attained its maximum elevation. The gradual descent of the snow-line as we advance southwards is shown by the fact of the Charang pass having an altitude of only 17,400 feet, and lying between the passes above named and the Bisahr range, being said to be never free from snow, though early in July it had already melted up to 16,300 feet. North of the Satlaj, under the peak Leo Porgyul, the surface was found to be free from snow in October up to 19,000 feet or even higher, while west of that river on the Manirang or Rupak pass, having an elevation of 18,600 feet, the summit was covered with newly fallen snow at the end of August, showing that the level of perpetual snow was nearly at its maximum. Snow was, however, met with on the road to the pass, but this was due to avalanches and drifts and to the fact of the road lying in a deep glen. Dr. Thomson, who visited the Kárakoram pass in August, 1848, estimated the snow-line on the journey back to Sásor at 17,500 to 18,000 feet but to the northward and eastward it was much higher, probably not less than 20,000 feet.[2] Trotter[3] also notes that the Kárakoram pass (18,550 feet) is always free from snow in summer, whilst the Sásor further south is seldom, if ever, free from snow.

Western Tibet.

Regarding the height of perpetual snow on the tableland of western Tibet Captain H. Strachey is still the best authority. He writes:—"from a series of minute observations on the snow-level, made during two years, in the course of which I crossed twenty-five passes elevated from 15,000 to 19,000 feet at various seasons between the end of

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[1] Tours in the Himálaya, II., 73, 117, 133, 242: Account of Koonawur, 157-9.
[2] Travels, p. 437. [3] Report, p. 11.

April and the beginning of November, I have arrived at the following conclusions. The snow-line in the central and northern parts of west Nári attains an extreme height of nearly 20,000 feet. It lowers on approaching the Indian Himálaya, and on the southernmost parts of the Indian watershed descends perhaps as low as 18,000 feet." The mountains under 20,000 feet in height in the northern and more open parts of the tableland will, he adds, be almost entirely denuded of snow during the latter part of the summer. General Strachey, during his visit to the tableland north of Garhwál during September, 1818, found snow only in patches in sheltered ravines, but the highest summits in the district through which he passed were only 18,400 feet. Perpetual snow was not found on any of the hills between the Indian water-parting and the Satlaj. The height of the snow-line on the south face of the peak of Kailás was observed in the month of September by means of a theodolite, and found to have an elevation of nearly 20,500 feet, and the altitude of a peak on the ridge between the Satlaj and the Indus which was only tipped with snow in August was in like manner determined to be 20,500 feet above the sea: so that, making a fair allowance for the difference between the northern and southern exposures, the mean snow-line was in both cases about the same. The limit of snow on the Pámír is reported to be between 16,000 and 17,000 feet and on the Alái Pámír about 14,000 feet.

Lakes.

Throughout Kumaon and Garhwál there are several lakes, but the chief in size and beauty occur in pargana Chhakháta, the Westmoreland of Kumaon. These are known as Naini, Bhím, Sát, Naukuchiya, Malwa, Khurpa, Sukha, Sariya, Khuriya, &c., with the affix '*tál*' or 'lake' attached. The following table gives some information regarding the principal lakes:—

Name.	Height above sea-level.	Greatest length.	Greatest breadth.	Greatest depth.	Approximate area.
	Feet.	Feet.	Feet.	Feet.	Square feet.
Naini Tál ...	6,107	4,733	1,518	93	5,149,000
Bhím Tál ...	4,500[1]	5,580	1,490	87	4,900,000
Naukuchiya Tál ...	4,000[1]	3,120	2,270	132	4,849,500
Malwa Tál ...	3,400[1]	4,480	1,833	127	4,909,600

[1] Approximate measurements.

It has been suggested that these lakes were formed by glacial action, but Mr. Ball in a recent paper[1] combats this view, and assigns their existence to landslips which closed up the valleys in which they occur. Be this as it may, they form one of the most remarkable and beautiful features of the Lower Himálaya in Kumaon. The lake of Naini lies in a valley which runs about north-west and south-east, and is surrounded on all sides except the east by lofty ridges, Sher-ka-danda, Chína (8,568 feet), Deopátha (7,989 feet), and Ayárpátha (7,721 feet). Bhím Tál lies in a comparatively open valley with a hill to the south of the lake rising some 1,300 feet above its level. Further east in the same valley is Naukúchiya Tál, occupying a hollow in the slope, and without any remarkable hills around it. The Sát Tál or seven lakes, lie within a circle of hills between Bhím Tál and the valley of the Naini Tál river, and Malwa Tál lies to the north of Bhím Tál in a deep valley, the sides of which rise up abruptly from the level of the lake. The only lakes of importance in Garhwál are the Gudiyar Tál in patti Dasauli Malli and Diuri Tál in patti Kóliphát Malla, neither of which can compare with the Kumaon lakes in size or beauty.

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[1] Rec., Geo. Sur., XI, 2, p. 171.

CHAPTER V.

METEOROLOGY.[1]

CONTENTS.

Preliminary sketch of climate. Contrast between the eastern and western parts of the plain and the Himálaya. Radiation, solar and nocturnal. Temperature:—Diurnal and annual ranges,—Vertical decrement,—Height of snow-line. Pressure and winds:—Barometric tides,—Mountain winds,—Annual variation of pressure,—Monsoons. Humidity:—Vertical distribution of vapour,—Relative humidity,—Cloud. Rainfall:—Distribution on plains and on the Himálayan slope,—Annual variation,—The winter rains,—The monsoon rains.

THE climatological conditions of these hill districts are a most important element in their physical geography, and will therefore require to be treated at considerable length. An exhaustive discussion of the meteorology cannot yet be attempted, but sufficient data have already been collected to serve as a basis for a general description of the climate, and at the same time to throw some light on several of the more interesting problems of meteorology. In this latter respect the Himálaya, on account of its less distance from the equator and its greater elevation, presents many points of advantage as compared with the Alps and other European mountain systems; and already some important general conclusions regarding the physics of the atmosphere have been drawn from the observations that have been made in it. The mere statement of the fact that nearly all the snowy peaks and most of the passes over the Indian watershed stand above the lower half of the atmosphere, and thus completely cut off all communication between India and Central Asia, except in the upper strata, indicates how much regarding the general movements of the atmosphere may be learnt from observations taken in India and the Himálaya.

Of late years, a good deal has been done in the way of collecting trustworthy meteorological data for the mountain zone by the establishment of Government observatories at certain points. The places where observations are made at the public expense must always, however, be few, and it is desirable that more should be done in the way of enlisting the services of volunteer observers. Temperature and rainfall observations are now made at many tea-gardens in Kumaon; but, as a rule, so little attention is paid to the hours of reading, the exposure of the instruments, and the continuity of the registers, that the results are of no value for scientific discussion and comparison. By far the most important of the observations taken in the north-west Himálaya, prior to the establishment of regular observatories, were those collected by Lieutenant (now General) R. Strachey, of the Bengal Engineers, in 1848 and 1849. Some of General Strachey's deductions from them have been given to the world in the *Proceedings of the Royal Society* and the *Journal of the Asiatic Society of Bengal;* but others have not yet been published, though they were long ago embodied in a work on the "Physical Geography of the Himálaya" that has been placed at the disposal of the compiler of this volume. Considering the scanty nature of the materials General Strachey had to work with, the conclusions arrived at were wonderfully accurate; and though some of them were opposed to the generally received opinions of the European meteorologists of the day, they have been confirmed in almost every respect by the more extensive data subsequently obtained from the Himálayan observatories.

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[1] Written by Mr. S. A. Hill, Meteorological Reporter to the Government of the North-Western Provinces and Oudh, for this volume.

In the following pages a somewhat detailed discussion of all the data available for meteorological inquiry will be given after a brief general sketch of the climate. The several elements of meteorological observation will be taken in the natural order of cause and effect, commencing with solar radiation and afterwards passing on to temperature, barometric pressure and winds, and the distribution of vapour and rain.

Sketch of climate.

The order of the three seasons on the plains of Upper India—the cold, the hot, and the rainy—is now well known even in Europe. After the close of the rains at the end of September or beginning of October the sky is serene and the atmosphere transparent. Owing to the absence of cloud and the rapidly diminishing proportion of water vapour, the air is also very diathermanous; that is, it permits the free passage of heat from the sun to the earth in the daytime, and in the calm nights that prevail at this season the radiation of heat into space goes on so rapidly that the earth's surface and the air resting on it become very cold before morning. The months of October and November are thus characterized, not only by clear skies and calms, but by a great temperature range and heavy dews at night. These conditions prevail through the greater part of December, and towards the end of that month and in the beginning of January, the exposed thermometer sometimes falls 10 degrees below freezing at places as far down the plain as Allahabad and Benares. In the Panjáb it is much colder, and there the shaded thermometer sometimes reaches the freezing point.

About the end of December and in January and February, however, clouds often interfere with the free radiation of heat at night, and the daily range of temperature for these months is less, on the average, than that of November. Some rain usually falls at this time of the year, especially in the Panjáb and the higher districts of the North-Western Provinces. In March and April the temperature rises rapidly, especially at a distance from the mountains, and the air becomes extremely dry. Hot winds from the west or north-west blow down the valley of the Ganges and rapidly change the appearance of the whole country from that of a highly cultivated plain to a parched and sandy desert, almost the only green things left being the groves of mango trees. In April, the daily range of temperature over the plains is at a maximum, exceeding 30 degrees in most parts of the North-Western Provinces and the Panjáb. The nights are still tolerably cool, though in the daytime the thermometer ranges as high as 110°F. or even higher sometimes.

During May and the first half of June the temperature continues to increase, though much less rapidly than in March and April, until by the 15th or 20th of June, if the periodical rains have not commenced, the temperature is probably higher in North-Western India than anywhere else in the world. In the North-Western Provinces the shaded thermometer has only been known to rise once or twice above 120°F., but in the Panjáb temperatures as high as 123° or 124° have been recorded. The days in June are thus only a few degrees hotter than those of April; but, as the rainy season approaches, the range of temperature diminishes and the nights become insufferably hot and close.

Rain seldom falls in the hot weather, the falls that *do occur* generally taking place during thunderstorms. About the middle of May, however, the quantity of water vapour in the air begins to increase rapidly, betokening the approach of the rainy season. This vapour is probably brought by the prevailing south-west upper current of the atmosphere which seems to descend gradually until it merges with the surface sea winds of the Bay of Bengal and forms "the south-west monsoon" or prevailing wind of the rainy season. In Northern India the lowest strata of the sea winds are deflected from their normal course by the mountains and directed towards the seat of highest temperature in the Panjáb, thus appearing as east or south-east and not as south-west winds. Along the foot of the hills these easterly winds are felt occasionally by the middle of May, when the quantity of vapour in the air first begins to show signs of a rapid increase.

During the latter half of June the sea winds increase in strength and gradually advance along the foot of the Himálaya, until, by the beginning of July, the rains have usually set in all over Northern India. In ordinary years rain continues to fall, not steadily but with frequent intermissions or "breaks," until about the end of September, when the easterly winds cease, except close to the hills, where they last a month longer, and are succeeded by calms or feeble currents from the west. In the Panjáb the rains begin later, are lighter and more intermittent, and end sooner than in the North-Western Provinces, and the length and intensity of the rainy season increase regularly as we approach the sea in Bengal. During the rains the temperature averages about 85° over the greater part of Northern India. The daily range at this time varies from 8 to 12 degrees, being greatest in the driest districts.

The extremes of heat and cold are much greater in the Panjáb and the upper part of the North-Western Provinces than in Bengal, for two reasons—the greater distance from the sea and the higher latitude. On account of its proximity to the sea and its heavy rainfall, Bengal is moist and cloudy at all seasons compared to the Panjáb. This condition of the atmosphere, by retarding the radiation of heat, renders the climate of Bengal more equable than that of the Panjáb, just as an insular climate is more equable than a continental one. Again, the latitude of the Panjáb, which is 7 or 8 degrees higher than that of Bengal, causes its winters to be much colder and its summers much hotter. At first sight it seems anomalous that a place should be the hotter the more distant it is from the equator, at any season of the year; but when it is borne in mind that the quantity of heat received from the sun is directly dependent upon the length of the day as well as on the elevation of the sun above the horizon, the anomaly disappears. Various mathematical physicists from Halley downwards, including Poisson[1] and more recently Meech,[2] have calculated the total heating effect of the sun in different latitudes during a day or other given period of time. The latest investigation of this kind has been made by Wiener[3] of Carlsruhe, who finds that while the maximum of heat for the whole year falls on the equator, the maximum for the 21st of June is at the north pole, where the sun remains above the horizon for twenty-four hours, and has an altitude of nearly 23½ degrees for the whole of that time. In the summer half year, from equinox to equinox, most heat falls on a zone about 25½° north of the equator, and during the three months nearest to the summer solstice—that is, from the 7th of May to the 6th or 7th of August, the zone of greatest heat lies about 41°N. The total heat received during these three months by an area in latitude 40° or 41°N. is more than a fifth greater than that which falls on an equal area at the equator. The actual increase of temperature produced is much more than this, for the mean temperature is determined by the balance between the gain of heat during the day and the loss at night. When the gain of heat from the sun at any place is greater than at the equator, on account of the length of the day, the loss at night must be correspondingly less.

This excess of solar heat in summer, together with the dryness of the air and the absence of cloud, seems to account for the excessively high temperature of June and July in the extreme north of the Panjáb and on the plains of Yárkand and Káshgar still farther north. In the moister zone of the mountains, the direct action of the sun is less observable; but beyond the Indian watershed it is by far the most important factor in determining the character of the seasons.

[1] *Theorie de la Chaleur*, 1835 edition, page 473.

[2] *Smithsonian Contributions to Knowledge*, Vol IX.

[3] *Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie*, Band XIV, page 133.

Regarding the succession of the seasons in the mountain zone, General Strachey says :—

"The same general sequence of the seasons takes place in the mountains as in the plains. Here, however, every altitude has its own special temperature, from the lower valleys where the heat is still overpoweringly great, to the regions of eternal frost ; but at all elevations in summer the force of the sun's rays is excessive. The summer rains, too, gradually diminish in strength as we move along the chain from east to west, being at their maximum in Sikkim, but still being felt slightly on the ranges north of Peshâwar. The heaviest falls invariably take place on those portions of the chain most exposed to the south ; increasing in amount up to a certain height [not very exactly determined, but probably about 4,000 feet]; at the same time every high and continuous ridge most sensibly diminishes the supply of rain that falls on the country to the north of it, and we find, as we approach the Indian watershed, that the quantity is very small, and that the monsoon only just drops a few partial showers on the southern border of Tibet. The winter, as may be supposed, is extremely rigorous on the summit of the table-land ; and at this season, or in spring, the only important precipitations of moisture take place in the form of snow, but they are exceedingly small in quantity."

The reason why every altitude has its own special temperature is that the air is warmed chiefly by contact with the hot ground on which it rests, and but little by direct absorption of the solar rays. The air in contact with the ground, expanding and becoming less dense, rises up, but in doing so its heat is rapidly converted into the work of expansion ; the result being that the temperature of the upper strata can never rise so high, on the average, as that of the air near the ground. Dry air, if heated only at the bottom, would lose 1 degree Fahrenheit for every 183 or 184 feet of ascent. In moist air that is precipitating rain, and thus being warmed by the latent heat of the condensed vapour, the rate of decrease is much less. The rate actually observed, both in balloon ascents and on mountain sides, is less than that calculated theoretically ; because even dry air is to some extent warmed directly by the sun's rays, while air saturated with moisture has a very considerable absorbing power. On mountain slopes also the temperature falls less rapidly than in the free air over the plains:—at all events for the first nine or ten thousand feet of ascent, the reason being that the air is heated by contact with the mountain sides.

Radiation.

No data at present exist from which the average intensity of solar radiation, and its variations from time to time, can be estimated with any approach to exactness. Any deductions made by passing from radiation to other meteorological phenomena must therefore to a great extent be based on theoretical considerations.

The instrument hitherto used to measure the intensity of the sun's heat has been a maximum thermometer with a blackened bulb surrounded by a thin glass case more or less completely exhausted of air. If the exhaustion were perfect, the temperature of the instrument would be determined by radiation to and from surrounding objects; including under these the glass case of the instrument which is in contact with the air, the sun, the ground, the clouds, and the open sky. Were solar thermometers all made exactly alike and exposed under absolutely identical conditions, the excess temperature of the instrument above the contemporaneous temperature of the air would be a measure of the excess of radiant heat falling on it from objects above the horizon over that which passes away from it in an upward direction. The following table gives the average value of this difference for each month at six stations. Corrections have been applied as far as possible for differences of instrument and exposure, except at Dehra, for which the corrections are not known:—

I.—Monthly mean excess temperature of the solar thermometer above the maximum in shade.

Stations.	Elevation in feet.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
		°	°	°	°	°	°	°	°	°	°	°	°	°
Leh ...	11,538	49·9	63·1	62 3	63 2	58·7	58·1	54·1	62·8	63 8	63·9	54·1	50 9	58·7
Chakráta,	7,052	71·1	67·1	69·4	69·5	69·1	66·3	63·0	61 5	70·3	69·8	69·4	68·5	67·9
Ránikhet,	6,069	61·1	60·6	62 6	60 4	60·3	57·1	50·8	52·1	59·8	57·3	52·7	55·7	57·5
Dehra ..	2,232	51·0	52·2	57 6	57 1	56·8	54·2	53 6	52·1	57 7	58·5	55·6	51·8	54·9
Roorkee...	887	52·2	51·5	55 9	54·6	53 7	51·2	51·9	51·8	54 5	51·5	55·1	52 5	53·3
Bareilly ...	568	50 0	52·6	51·1	54·4	55·3	54 2	50·7	50·1	49·3	52·0	52·4	48 9	52·0

If the air were absolutely diathermanous, the altitude of the sun above the horizon and the vertical thickness of the atmosphere above the place of observation should have no effect upon the temperature differences in the table, which should therefore be the same for all the stations and for every month of the year. But the air having some absorbing power, the differences should be greatest when there is least air for the sun's rays to pass through; that is, at the highest stations and in the summer months. Up to Chakráta the excess temperature of the solar thermometer does increase with a fair degree of regularity; but it appears to be less at Leh than at Chakráta, contrary to all theory. There is also no regular increase apparent in the heating power of the sun as the season changes from winter to summer. The truth is that the indications of the black-bulb thermometer are affected by so many disturbing causes, that after all possible corrections they are of little or no value for inter-comparison; though with the same thermometer, at the same place, and under absolutely constant conditions of exposure, the figures for one year may be to some extent comparable with those for another.

The results of observations with the nocturnal radiation thermometer are even more unsatisfactory, owing to differences in the height of the instrument above the ground and in the nature of the ground surface itself, whether grassy or bare.

II.—Monthly mean depression of the grass thermometer below the minimum in shade.

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
	°	°	°	°	°	°	°	°	°	°	°	°	°
Chakráta,	9·5	6·5	7·2	7·5	6 9	6 0	3·1	1·3	5·8	8·8	9·8	11·0	7·2
Ránikhet.	14·5	13·6	13·9	13·3	12·0	9·0	5·3	6·0	8·9	13·5	17·2	19·1	12·2
Dehra ...	4·4	4·1	4·2	4·7	4·8	3 6	2·2	1·5	2·3	3·5	4·8	4·6	3·8
Roorkee...	6 3	5 8	6 4	6 3	5·0	3·5	2·4	2·9	3·9	6·8	7·3	6·3	5 2
Bareilly...	7·0	7·5	8·0	10·0	10 5	8·8	4 3	3·3	3·1	6·4	8·2	8 0	7 1

The figures in table II. serve to show that the depression of the nocturnal radiation thermometer below the minimum in shade is less in the rainy season than in the dry, and that both at the hill stations and on the open plain the refrigeration of the earth's surface during the night is probably greater than at Dehra, where the observatory is situated in a well-wooded park. They do not throw any light on the question whether the ground surface cools more rapidly at night on mountain tops or on the plains; though it is probable that in the clear, calm nights of the cold weather the difference, if any, is in favour of the plains; since there the air cooled by contact with the ground remains in contact with it, whereas on the mountains the cooled air constantly drains away, and is replaced by warmer air from the surrounding free atmosphere.

Temperature.

It has been already stated that, in the western Himálaya, every elevation has its characteristic mean annual temperature. Each elevation has probably also a distinctive form of variation of temperature during the year, and the daily variation is different at different altitudes, in range if not in general form.

For a proper discussion of the distribution of temperature in a hilly country a very large number of observations would in most cases be required; and these should be made at places chosen so as to be at nearly equal distances from each other vertically, and at the same time fairly distributed in latitude and longitude. On the southern slope of the Himálaya it fortunately happens that differences of latitude and longitude make but little difference in the mean annual temperature. The sea-level values of the mean temperature at the Sub-Himálayan stations from Lower Asám to Ambála all lie between 76 and 78 degrees Fahrenheit, and the temperatures of places at about 7,000 feet elevation along the whole range from Darjiling to Marri in the north of the Panjáb do not differ more than 2 or 3 degrees.

Both along the plains and at the level of the hill sanitaria the highest mean temperatures are found to characterize the regions lying between the Káli and Satlaj rivers. The chief reason for the great uniformity of mean temperature at the same elevation that prevails over the whole Himálayan region—that is to say, through more than 7 degrees of latitude and 17 of longitude—is the greatly increased heat of summer in the north-west as compared to the east. In Bengal and Sikkim the sun's rays when most intense are to a great extent cut off by cloud, whereas in the Panjáb and the north-west Himálaya the winter is almost if not quite as cloudy as the summer. For these reasons Darjíling has very nearly the same temperature in January as Simla, Chakráta, or Mussooree, while in May and June it is seven or eight degrees cooler. The comparatively low temperature of the summer at Darjíling renders the mean for the year nearly two degrees lower than that of Marri in the extreme north-west, though the effect of latitude is apparent in the low temperature of Marri in January.

On account of this uniformity of temperature a small number of observations, at places chosen specially with reference to height above the sea, will enable us to ascertain the most important features of *temperature distribution in the Himálayan districts of the North-Western* Provinces. The following table gives the mean monthly temperatures of twenty-one places, including the two stations on the plains that were given in the previous tables. All the other places except Dharmsála lie in one or other of the three districts of Kumaon, Garhwál, and Dehra Dún, or in parts of Kunáwar, Lahúl, and Ladák to the north of Dehra Dún. The monthly means from a Government observatory at Dharmsála in the Panjáb have been inserted, though this station lies nearly two degrees west of Dehra Dún, because it was considered desirable to have some trustworthy figures for places about 4,000 feet above the sea ; and the only other station near that altitude is Háwalbágh in Kumaon, for which we have but one year's observations.

III.—*Mean monthly and annual temperatures of places in Kumaon, Garhwál, Dehra Dún, and adjacent districts.*

Place.	Latitude N.	Longitude E.	Elevation in feet.	January.	February.	March	April.	May.	June.	July.	August.	September.	October.	November	December.	Year.	Number of years
BAREILLY ...	28°21′	79°27′	568	57·3°	63·0°	73·0°	83·4°	89·1°	90·3°	84·8°	84·0°	83·0°	76·4°	66·5°	58·6°	75·8°	11
ROORKEE ...	29 52	77 56	887	56·7	61·1	70·5	81·5	87·9	90·8	85·2	84·1	82·7	75·5	65·0	57·5	74·9	17
Srinagar ..	30 15	78 50	1,950	...	...	...	71·0	80·0	84·0	79·0	84·0	79·0	...	..	.	...	1
Kálsi ...	30 30	77 50	2,000?	58·3	61·0	62·6	77·7	81·2	86·0	83·7	80·2	77·2	70·8	63·2	59·7	71·8	1—2
DEHRA ...	30 20	78 8	2,232	54·8	58·0	65·8	76·1	82·1	84·9	80·2	79·0	77·3	70·4	62·5	56·2	70·6	12
Háwalbágh ...	28 38	79 37	4,114	47·0	55·0	61·0	66·0	73·0	76·0	78·0	79·0	75·0	69·0	60·0	52·0	65·8	1
DHARMSÁLA ...	32 20	76 35	4,495	44·6	49·4	57·3	68·3	72·3	75·8	70·7	69·6	69·0	64·6	57·7	50·5	62·5	4—5
Pauri ..	30 10	78 55	5,350	...	...	...	60·0	69·0	73·0	72·0	69·0	67·0	61·0	...	...	...	1
Almora ...	29 35	79 38	5,546	46·3	52·2	57·4	64·7	70·3	75·0	73·2	72·5	72·5	63·4	57·9	51·2	63·2	6—7
Lohughát ..	29 24	80 4	5,649	44·5	45·8	52·3	60·9	66·0	71·0	71·1	70·7	68·7	63·1	51·9	46·4	59·4	2—3
Mussooree (1) ...	30 21	78 10	5,850	45·6	47·0	57·2	63·5	67·0	70·8	66·4	65·3	65·2	63·0	56·6	47·6	59·6	1—3
RANIKHET ...	29 38	79 29	6,069	46·1	49·2	56·8	65·2	67·8	71·3	67·9	67·2	66·4	61·0	55·7	50·2	60·4	9
Naini Tal ...	29 20	79 31	6,463	42·8	45·3	55·5	60·4	66·0	69·1	68·4	67·3	65·4	59·3	52·7	46·6	58·2	10
Mussooree (2) ...	30 28	78 7	6,937	41·5	43·8	52·0	59·6	65·6	68·5	64·7	64·1	63·0	57·3	52·3	46·5	56·7	2-14
CHAKRÁTA ...	30 40	77 55	7,052	41·6	43·7	50·4	59·6	64·6	68·0	64·5	64·1	63·0	57·5	52·2	46·6	56·3	11
Landaur ...	30 27	78 11	7,511	37·8	44·1	49·1	56·3	63·2	68·5	65·3	63·9	64·3	56·4	49·4	44·1	55·2	4—5
Kánam (Kunáwar)	32 0	78 30	9,296	28·8	34·6	37·2	46·6	56·7	63·7	66·6	65·0	61·3	51·7	42·6	36·1	49·4	2
Kardong (Lahul),	32 34	77 1	10,242	24·0	36·0	44·0	47·0	49·0	54·0	63·0	60·0	52·0	46·0	37·0	27·0	44·9	1
Niti ...	30 48	79 34	11,464		...	..	...	...	...	58·0	58·0	55·0	...	...	...	...	1
LEH (Ladák) ...	34 10	77 42	11,538	17·6	22·1	30·3	40·1	46·6	53·6	60·5	57·5	49·9	37·9	30·7	24·4	39·3	2—7
Spiti Valley ...	32 10	78 0	13,000	17·5	18·7	22·3	37·5	45·9	56·9	61·7	55·3	52·7	38·3	22·5	17·2	37·2	1

Authorities for the above table.

BAREILLY	Registers of the Government Meteorological Observatory, 1869 to 1879
ROORKEE	Ditto, ditto, 1863 „ 1879
DHARMSÁLA .	Ditto, ditto, 1871 „ 1875
RÁNIKHET :	Ditto, ditto, 1871 „ 1879
CHAKRÁTA :	Ditto, ditto, 1869 „ 1879
LEH :	Ditto, ditto, 1871 „ 1877
DEHRA	Registers of the Observatory at the G. T. Survey Office, 1868 „ 1879
NAINI TAL	Registers of Government Observatory, 1863 to 1869, and observations by Dr. Payne in 1851-54, given at page 196 of the third volume of the *Results of a Scientific Mission to India and High Asia*, by the brothers Schlagintweit.
MUSSOORIE (1):	Records of an observatory at Saint Fidelis's School for 1877-80; somewhat fragmentary.
(2):	November to April, Sir A. Waugh's and Mr. Mackinnon's observations in 1855-56, also one year's observations from Dove's tables; May to October, observations at the Survey Office for 1866-79, furnished by Mr. Hennessey, F.R.S.
LANDAUR :	Registers kept at the Convalescent Hospital in 1852-54, and 1866-67. Observations for the three years 1877-79 have been communicated by the medical officer in charge, but the means deduced from them appear to be 4 or 5 degrees too high.
KÁLSI .	Pigot—*Calcutta Journal of Natural History*, Vol. VI., 1837-38.
ALMORA :	Observations at the Regimental Hospital, 1852-54 and 1866-69.
HAWALBÁGH :	Schlagintweit, page 194, on authority of Mr. Batten; year unknown.
LOHUGHÁT :	Clelland's *Geology of Kumaon*, page 179, parts of 1830, 1831, 1834, and 1835.
KARDONG :	Schlagintweit, page 513; 1855-56.
KANAM :	Cunningham's *Ladák*, page 184;[1] 1827-28.
SPITI VALLEY	Ditto, page 183;[2] 1846.
SRINAGAR PAURI : NITI :	Manuscript observations by General Strachey and his brothers, 1847-49

The figures for the regular meteorological observatories (printed in small capitals in table III.) and those for the observatory at the Survey Office, Mussooree, are either directly calculated from observations at 4 A. M., 10 A. M., 4 P. M., and 10 P. M., or have been corrected to represent the means of observations taken at these hours. They probably differ very little from true daily means. The mean temperatures for the other places have been calculated in various ways, and many of them are open to considerable doubt.

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[1] Recomputed from the maxima and minima and corrected by means of the observations of Chakráta and Leh. [2] Recomputed and corrected by the Leh observations.

The mean annual temperature diminishes pretty regularly as height increases. In the table there are only two exceptions to the rule that the higher a place is the cooler it is. It will be seen also on comparing places of nearly equal altitude and not very far apart that the highest temperatures belong to those which, lying behind the outermost high ridge, are subject to a much smaller rainfall than stations situated on the ridge or in valleys opening out to the south and exposed to the full force of the rainy winds. Thus Ránikhet and Almora are too hot in comparison with Naini Tál. The difference in temperature as well as in humidity between places situated at equal heights on the outer and inner ranges of Kumaon is sufficiently great to be easily recognizable without the aid of instruments, and is well known to all who have ever resided in the hills. The variation of temperature between the hottest and coldest months and the daily range of the thermometer are also greater, as a rule, in the interior than on the outer hills, owing to the larger proportion of cloudy sky and greater humidity of the air in the latter region.

Both the diurnal and the annual range of temperature decrease on ascending from the plains up to a height of 6,000 or 7,000 feet, and beyond that they again increase, their greatest values being attained at the highest stations where observations have been made. These places, however, lie to the north of the Indian watershed, where the humidity is doubtless less than on the southern side, and the observed ranges of temperature are probably higher than they would be at equal altitudes on this side of the snowy range. Moreover, the annual range in Tibet and Ladák is greater than on the Indian side of the chain on account of the difference of latitude, as has already been pointed out. In table IV. the daily and yearly ranges of temperature at twelve places are compared, and from it these relations will be readily seen.

IV.—Mean diurnal and annual ranges of temperature at places in the Himálaya.

Place.	Diurnal Range.													Annual range of monthly means.
	January.	February.	March.	April.	May.	June.	July.	August	September	October.	November.	December.	Year.	
	°	°	°	°	°	°	°	°	°	°	°	°	°	°
Bareilly ...	26·8	25·5	28·0	31·0	28·3	22·1	14·2	11·2	15·0	24·3	30·4	28·0	23·9	33·0
Roorkee .	26·5	24·6	28·3	31·4	28·9	22·2	11·5	11·6	17·2	27·8	32·9	29·3	24·8	34·1
Dehra ...	23·4	23·1	24·0	26·3	24·9	18·6	12·8	12·5	15·0	23·4	25·9	24·3	21·2	30·1
Dharmsála ...	15·8	18·6	20·4	21·3	21·6	18·2	12·6	12·6	15·4	19·6	20·2	18·5	17·0	31·5
Mussooree, (1),	14·0	13·2	14·0	16·0	19·3	15·4	9·4	8·0	10·3	13·6	16·3	12·3	13·2	25·2
Ránikhet ..	16·1	17·0	18·2	18·6	18·1	15·0	11·2	10·9	13·1	15·3	17·2	16·1	15·5	25·2
Mussooree, (2),	...	...	...	...	19·0	16·5	10·7	9·9	12·0	11·2	16·8	...	...	27·0
Chakráta ..	18·3	18·4	18·1	19·7	19·4	16·3	12·5	11·9	12·0	17·3	18·0	18·3	16·6	20·4
Landaur ...	15·3	18·7	18·2	19·7	20·0	21·2	13·1	9·5	12·2	16·5	17·0	18·2	16·0	28·8
Kanam ...	15·2	17·2	22·0	19·0	18·5	17·3	16·3	15·5	33·9	20·5	19·0	18·3	18·1	37·8
Leh ...	28·5	30·0	28·0	31·0	30·1	31·8	11·2	31·3	31·4	30·5	26·7	25·2	29·6	42·9
Spiti ...	19·3	27·7	20·2	18·5	22·0	20·0	32·1	31·3	28·4	28·0	18·0	32·2	28·7	44·5

The table shows clearly that the minimum range for both day and year is reached at Ránikhet and the lower Mussooree station—that is, about 6,000 feet above the sea. The dependence of the diurnal range upon the humidity of the air and the proportion of cloud at each station is distinctly brought out in the variations from month to month. At all the stations but Leh and the Spiti valley, which lie beyond the snowy mountains, the months of the year which are driest in India—April and May—have the largest daily thermometric range, and the most humid months—July and August—have the smallest. There is a secondary minimum of temperature range coinciding with a maximum of humidity in January, and a secondary maximum in the dry and cloudless month of November. At Leh, where the most frequent precipitation of moisture during the year takes place in winter, the range is somewhat greater in the summer than in the winter months.

Owing to the greater annual range of temperature on the plains than on the hills, the diminution of temperature in the first 6,000 feet of ascent is most rapid in the hottest months and least so in the cold season. Between Roorkee and Chakráta the difference is less than 11 degrees in December and more than 23 in May. In the clear still nights of the cold weather, especially in November and December, before the winter rains and snows set in, the nocturnal loss of heat goes on almost as freely on the plains as on mountain peaks. It is thus not unusual to find the temperature of the exposed thermometer at Roorkee nearly as low as at Chakráta, and it very frequently falls lower at Roorkee than at Dehra, where the observatory is surrounded by trees. In December the mean temperature diminishes between Roorkee and Dehra at the rate of only one degree in 1,034 feet, while in May and June it falls one degree in 230 feet.

The low temperature of the plains in the winter season, especially in the morning, is doubtless due in part to the draining down of cold air from the mountain slopes through the river gorges. This, however, cannot appreciably affect the temperature of places at a long distance from the mountains, though it may have a very considerable effect on that of Roorkee, close to the foot of the Siwáliks. The minimum temperature of the day is thus one or two degrees lower on the average at Roorkee than at Dehra in the months of November and December, and in January the minimum temperatures of the two places are equal. In the mountain country itself it often happens for the same reason that the temperature of the air at the bottom of a valley is distinctly lower than on the adjacent ridges. A similar inversion of the normal variation of temperature with height has been noticed in Europe during calm weather in winter.

From March to June the absorption of heat in melting and evaporating the snow on the outer hills, and in evaporating the rain that falls there in frequent showers when no rain falls over the plains, keeps down the temperature; so that in May and the first half of June, when the plains are at their hottest, the decrease of temperature on ascending through 6,000 or 7,000 feet is more than twice as great as in December.

In the Panjáb, where the latitude is higher and the humidity of the air over the plains is never great, the annual range of temperature at places on the plains is higher than in the North-Western Provinces, while in the hills there is much less difference. The annual variation in the decrease of temperature with height is accordingly much more distinctly marked in the extreme west of the Himálaya than it is in Dehra Dún. The difference of temperature between Ráwal Pindi and Marri is 19·5 degrees in July and only one-third as great in December. On the other hand, in the eastern Himálaya, where the air at all elevations up to 9,000 or 10,000 feet is nearly equally moist, and where the range of temperature, especially over the plain, is much less than in the north-west, the decrease of temperature with height is most rapid in February and March and least so in June and July. The slow rate of decrement in the rainy season is doubtless due to the liberation of latent heat in the condensation of vapour; this heat rendering the atmospheric strata in which condensation occurs warmer than they otherwise would be, while the constant precipitation of rain prevents the lower strata from becoming very much hotter than the rain drops which pass through them. The effect of the rainy season in retarding the fall of temperature as we ascend is distinctly seen between Bareilly and Naini Tál or Ránikhet, but is not seen between Roorkee and Chakráta.

The great annual range of temperature at more elevated stations, especially such as lie behind the first snowy range and receive little or no precipitation, causes even greater differences in the rate of decrease of temperature with height, but in the opposite direction. In January, the difference of temperature between Chakráta and Leh is 24 degrees, but in August it is only 4 degrees. The greater length of the day in summer at Leh, and the absence of cloud to obstruct solar radiation on the surrounding mountain sides, render the summer months at that station, 11,500 feet above the sea, as hot as they would be on the southern side of the snowy mountains at an elevation of 8,500 or 9,000 feet. If General Cunningham's figures for the temperature of the Spiti valley are to be trusted, the heat of summer at an elevation of 13,000 feet is still more excessive. The relation of this to the greater height of the snow-line on the northern than on the southern side of the Himálayan system is obvious.

In the following table the mean rate of decrease of temperature in the first 6,000 or 7,000 feet of ascent has been worked out for each month. In Dehra Dún the lower station is Roorkee and the upper one Chakráta; in Kumaon, Bareilly has been taken for the lower station, and instead of choosing either Naini Tál or Ránikhet for the upper one, the monthly mean temperatures of both places have been taken and assigned to the mean elevation of the two. This was considered preferable to taking the figures for either hill station alone, because Ránikhet appears to be a little hotter than the average of places at the same elevation, and Naini Tál is probably somewhat cooler than the average.

V.—Decrement of temperature with height in the Himálaya.

Month.		*Dehra Dún, difference of elevation, 6,165 feet*		*Kumaon difference of elevation, 5,698 feet.*		*Mean rate of decrease.*	
		Difference of temperature.	Height for 1°.	Difference of temperature.	Height for 1°.	Height for 1°.	For 1,000 feet.
		°	Ft	°	Ft.	Ft.	°
January	...	15·1	408	12·9	442	425	2·85
February	...	17·4	354	15·7	363	358	2 79
March	...	20·1	307	17.1	333	320	3·13
April	...	22·9	270	20·6	278	274	3·65
May	...	23·3	265	22 2	257	261	3 83
June	..	22·8	270	20·1	283	277	3·61
July	...	20·7	298	16·7	311	319	3·14
August	...	20 0	308	16·7	341	325	3·08
September	...	19 7	313	17 1	333	323	3 09
October	...	18·0	343	16·3	350	356	2·81
November	...	12·8	482	12·3	463	473	2·11
December	..	10 9	567	10 2	559	563	1 78
Year	...	18·6	331	16·5	315	338	2·96

In Dehra Dún there is a regular annual periodic variation in the rate of decrease of temperature with height, but in Kumaon the regular variation is interrupted in July and August, when the rate of decrease is slightly retarded by the fall of rain, as has been explained above. When the mean for both districts is taken, the regular variation from month to month is only slightly broken in August.

The figures given in the table include not only the decrease of temperature due to increase of elevation above the sea, but also a certain diminution caused by an increase of latitude equal to about a degree in 6,000 feet of elevation. The change of temperature with latitude in the Himálaya is small and to some extent masked by the contrast between the sunny valleys of the interior and the cool and cloudy outer ranges, but nevertheless it exists. On the plains of the North-West Panjáb the temperature falls as the latitude increases at a mean rate of about 1·1° F. for each degree of latitude, when corrections are made for differences of height above the sea. Probably much the same rate obtains in the western Himálaya at moderate elevations. The mean temperature of Yárkand, in latitude

39° N. and 4,200 feet above the sea, appears from the observations of Captain Trotter, R.E., of Drs. Bellew, Henderson and Scully, to be about 54°F. At the same elevation in Kumaon the mean temperature is between 65° and 66°, and since the difference of latitude is ten degrees, the temperature appears to diminish about 1·1° or 1·2° for a degree of latitude. There is also a certain variation of the mean temperature with the longitude, places situated towards the east of the chain being cooler than those towards the west on account of the cloudiness of the summer months. In order to determine the true variation of temperature with height it is necessary to make allowance for these variations in latitude and longitude. The mean annual temperature of any place in the western Himálaya may thus be looked upon as a function of four quantities—(1) the sea-level temperature at a point taken as the zero of latitude and longitude, (2) a constant multiplied into the height of the place above the sea, (3) a constant multiplied into the latitude, and (4) a constant multiplied by the longitude. From the Schlagintweits' work and the reports of the Indian Meteorological Department fairly trustworthy mean temperatures for about thirty places in the Himálaya between the Nepál frontier and the Indus can be obtained, more than half of these being given in Table III. When treated by the method of least squares the observations admit of being thrown into the form $T = 78{\cdot}5^\circ - {\cdot}00277h - 1{\cdot}20\ (\lambda - 29^\circ) - {\cdot}105\ (L - 73^\circ)$, a formula which represents the observations with a mean error of *about three-quarters of a degree. It ignores, of course, the differences* of temperature between such places as Almora or Ránikhet and others of equal elevation on the outermost range. The decrement of temperature with height when latitude and longitude remain unchanged appears therefore to be 2·77 degrees in 1,000 feet or 1° in 361 feet. In the eastern Himálaya the decrease is more rapid, the observations taken at Darjiling and Gwálpára giving a mean rate of 1° in 320 feet. At great elevations on the table-land, too, it is probable that the temperature diminishes more rapidly than on the southern slope of the mountains. General Cunningham's observations in Spiti and Rúpshu during the month of September, 1847, give a mean increase of about 280 feet in elevation for one degree of fall in temperature; and from the observations taken by Dr. Scully on the return journey from Yárkand over the Karakoram pass and through Ladák in September, 1875, Mr. Blanford has deduced a mean fall of temperature equal to one degree in 227 feet.[1]

The isotherms for equal altitudes in the western Himálaya and Ladák run from about W. 6° N. to E. 6° S., being thus three points less inclined to the parallels of latitude than the general direction of the mountain axis; but in eastern Tibet, Nepál, and Sikkim they probably bend to the southward. The mean temperatures of Káthmandu and Darjíling, at elevations of 4,354 and 6,912 feet above the sea, appear from the observations of ten years to be 61·7 and 53·9 degrees respectively, but according to the preceding formula they should be 66·7° and 60·1°. The mean temperatures of the four stations, Darjíling, Káthmandu, Gwálpára, and Sibságar, in the eastern Himálaya and Asám, may be represented very accurately by the formula $T = 77{\cdot}7^\circ - {\cdot}00312h - 1{\cdot}53\,(\lambda - 26^\circ) - {\cdot}23\,(L - 85^\circ)$. In this part of the chain the temperature decreases at a mean rate of one degree in 321 feet of ascent, and the isotherms run from W. 10° N. to E. 10° S., the direction of the mountain axis being nearly due east and west. The isotherms are thus slightly curved, with the concavity towards the south-west, whilst the general line of the mountains is considerably curved in the opposite direction. This is merely another form of the statement in page 209, that the highest temperatures characterize that part of the chain between the *Nepál frontier and the Satlaj.*

Supposing the uniform rate of decrease worked out in Table V. to hold good for the whole southern slope of the North-West Himálaya, since the difference of latitude is nearly propotional to that of height, a mean temperature of 49°F., equal to that of London, would be attained at a height of 9,600 feet, and the annual range of temperature would probably differ little from that observed in England. The hill sanitaria, lying between 6,000 and 7,000 feet, possess climates comparable, as regards temperature, to those of Nice, Mentone, and other health resorts in the Riviera; all the towns along the cost of France and Italy from Marseilles to Florence having mean temperatures between 58° and 60°F. The annual range of the monthly means at the Himálayan stations does not exceed 25 or 26 degrees, whereas on the Mediterranean coast it varies from 28 or 29 degrees at Nice to 35 or 36 at Florence and Rome.

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[1] *Indian Meteorological Memoirs*, Vol. I., page 222.

Nice and Ránikhet have exactly the same mean temperature, but Nice is seven or eight degrees hotter than Ránikhet in July and August, and several degrees colder all through the winter and spring months, except in January, when the temperatures of the two places are nearly equal.

At the superior limit of natural forest in the Himálaya, about 12,000 feet above the sea, the mean temperature is probably ten degrees above freezing. In the Alps a species of pine, *P. cembra*, forms natural forests on the borders of perpetual snow, where the mean temperature is several degrees under the freezing point. This difference of habit between the Himálayan and Alpine pines is very curious, and it is difficult to suggest any reason for it, since the natives of the Himálaya and Tibet find little difficulty in growing poplars and fruit trees in sheltered situations up to 13,000 feet or higher.[1] A mean temperature of 32° would be attained at a height of 15,400 feet, which is 2,000 feet above the upper limit of cultivated trees in Tibet.

The zone which has a mean temperature of 32° in any month will probably be near the lower edge of the snows in that month, especially in summer, when the light falls of snow on the outer hills have been all melted away. If the height of this zone be calculated for every month, the highest value obtained will be near the perpetual snow-line. With the uniform rate of decrease given in the last column of Table V., the result for July and August, when the snow line is highest, is about 17,630 feet. This result is very much higher than that given in Humboldt's *Asie Centrale*, on the authority of some of the earliest European travellers who penetrated into the country. General Strachey has, however, shown[2] that some of these mistook the lower limit of glaciers for the line of perpetual snow. The elevations of the snow line on the Trisúl and Nanda Devi groups of peaks, determined by trigonometrical observation from Almora in the latter part of 1848, before the winter snows set in, varied, according to Strachey, from about 17,000 feet on the eastern face of each group to 15,500 on the west; this latter was, however, in part probably newly fallen autumnal snow. The conclusion from these observations was that the height of the snow-line on the "more prominent points of the southern edge of the belt (of snowy mountains) may fairly be reckoned at 16,000 feet at the very least." The Schlagintweits found that the average height of the snow-line on the southern face of the Himálaya from Bhután to Kashmir was 16,200 feet. At page 72 of General Cunningham's book on Ladák the mean height of the snow-line on the peaks north of Simla, determined trigonometrically, is given at 16,665 feet, the highest point observed being about 1,000 feet higher; and in Mr. Drew's volume on the Kashmir territories, published in 1875, the elevation of the snow-line on the outermost zone is stated to be 16,500 feet. The height obtained by calculation as above suggested is thus probably a little too great, though it comes surprisingly close to some of Strachey's observations on Nanda Devi and those of Cunningham on the peaks of Kulu. Some observations have recently been made by the Trigonometrical Survey officers at Mussooree to determine the height of the snow-line on the peaks above Jamnotri, but the results have not yet been published.

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[1] Schlagintweit's *Meteorology of India*, page 565.

[2] *Journal of the Asiatic Society of Bengal*, April, 1849.

For the ranges north of the Indian watershed we have not sufficient data to calculate the approximate height of the snow-line from temperature observations; but the high temperature of Leh and the Spiti valley in July and August show most distinctly that it must be much higher than on the southern side. The limit of perpetual snow on the ridges bordering on Tibet, especially those which lie beyond the Satlaj, is given by Strachey as 19,000 feet at least. Dr. Gerard many years ago, and more recently Mr. Drew, assigned an elevation of 20,000 feet to the limit of the snow in Rúpshu. One reason why this limit is so high—the intensity of solar radiation in summer—has already been mentioned; another is the insignificant quantity of snow that falls each winter in these regions that are almost completely cut off from the great southern vapour currents.

The lower limit of the snow in winter is usually about 6,500 feet in Kumaon and somewhat lower in Dehra Dún and the hills north of the Panjáb. While it lies the temperature does not rise much above 32°, but it seldom falls in sufficient quantity to lie more than a few days at a time. About one year in ten the snow comes down as low as 5,000 feet. The lowest level attained in the first half of the present century was about 3,000 feet in 1817 and 1847. In 1877 and 1878, though the snowfall was heavier than it had been for many years, it did not come down much below 5,000 feet. A slight fall of snow is said to have been observed at Lahore on the 12th of January, 1874,[1] but no notice of this unprecedented occurrence was taken in the meteorological report for that month.

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[1] *Pioneer*, 17th January, 1874.

Atmospheric pressure and winds.

One of the most important effects of solar heat upon the atmosphere is the disturbance of its statical pressure relations, which in turn gives rise to those movements of adjustment towards equilibrium that are recognised as winds. The diurnal heating and cooling of the air causes certain oscillatory variations of pressure called the barometric tides, and gives rise to wind movements, such as the land and sea breezes and certain mountain winds that will be described below. The great annual change of temperature between summer and winter, in like manner, causes an annual variation in the height of the barometer and sets up those great currents of the lower atmosphere that are called the monsoons. Since the temperature is constantly changing no such thing as a simple statical distribution of pressure ever exists, though the averages of long series of observations may approximate more or less nearly to what a statical distribution would be. The air is constantly in motion either horizontally or vertically, and these movements cause variations of pressure, just as variations of pressure produce movements. Cause and effect, as regards pressure variations and winds, are thus so inextricably mixed up that it is next to impossible to disentangle them and show their relations clearly.

There can be little doubt that both the daily and the yearly inequality of pressure grow less as we ascend; and the annual variation at least becomes quite altered in character at a moderate elevation; but since the barometric variations depend upon the range of temperature which is possibly very great at great altitudes, while at a height of 6,000 or 7,000 feet it is less than on the plains, the decrease of the pressure variations with height is not strictly proportional to that of the total pressure. Table VI. gives the mean monthly pressures at a number of stations, and Table VII. the average daily range between 9-30 or 10 A.M. and 3-30 or 4 P.M. The figures for Bareilly, Roorkee, Dehra, Mussooree (both stations), Ránikhet, Chakráta, and Leh, have been corrected for the index errors of the barometers and are thus comparable with each other, except in so far as the different lengths of the periods of observation may cause the averages to differ; the others involve an unknown barometer error, which does not, however, affect the range of pressure, either diurnal or annual.

VI.—Monthly and annual means of Pressure at places in the Himálaya.

Place.	Elevation in feet.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	Number of years
		″	″	″	″	″	″	″	″	″	″	′	″	″	
Bareilly ...	568	29·417	29·366	29·263	29·148	29·003	28·924	28·931	29 002	29·097	29·263	29 393	29·439	29·187	11—12
Roorkee ...	887	29·123	29 057	28·967	28·856	28·744	28·615	28·629	28 694	28 796	28·959	29 090	29 132	28·888	12
Dehar ...	2,232	27·734	27·689	27·632	27·553	27·463	27·346	27·348	27·403	27·495	27·638	27·740	27·703	27·567	12
Dharmsála ...	4,495	25·478	25·449	25·442	25·429	25·361	25·318	25·296	25·323	25·465	25·545	25 624	25·620	25 446	2
Almora[1] ...	5,546	24·704	24·622	24·668	24·588	24·542	24·422	24·434	24·462	24·578	24 710	24 771	24·731	24·603	1
Mussoorce (1),	5,855	24·287	24·284	24·304	24·250	24·211	24·123	24 104	24·143	24·217	24·290	24·321	24 323	24·238	1—3
Ránikhet ...	6,069	24·096	24 076	24·070	24·066	24·010	23 932	23·926	23·939	24·023	24·106	24·157	24·134	24·046	5—7
Naini Tál ...	6,463	23·865	23·834	23·858	23 832	23·760	23·687	23·693	23·716	23·758	23·879	23 905	23 894	23·807	5
Mussooree (2),	6,881	...	...	...	...	23·334	23 267	23·249	23·294	23·358	23·439	23·492	23 423	...	1—14
Chakrâta ...	7,053	23·259	23·220	23·243	23·238	23·194	23·133	23·113	23·158	23 223	23·293	23·303	23·287	23·222	4—5
Leh ...	11,503	19·604	19·578	19·640	19·649	19·668	19·650	19·616	19·640	19·692	19·722	19 742	19·701	19 659	4—6

[1] From one year's observations by General Strachey.

VII.—Mean diurnal and annual ranges of pressure at places in the Himálaya.

Place.	DIURNAL RANGE, 10 A. M. TO 4 P. M.													Annual range of monthly means.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	
	″	″	″	″	″	″	″	″	″	″	″	″	″	″
Bareilly	.105	104	107	·118	·119	·112	·096	·097	·107	·105	·108	·108	·107	·515
Roorkee	·093	088	·089	·099	097	·106	·083	·088	·099	·094	·091	·095	·093	·517
Dehra	·087	087	·082	·090	·090	·086	·070	·076	·092	·092	·093	·089	·086	·417
Almora	·090	·090	090	·090	·080	·090	·080	·080	·090	·100	·090	·100	·090	·349
Mussooree (1)	·047	·050	·041	·038	·052	·063	·045	·057	·060	·047	·042	·073	·051	219
Ránikhet	068	·064	·056	·060	·036	·052	·052	·055	·058	·062	·065	·060	·059	·231
Naini Tal	·066	·063	·056	·053	·054	·045	·042	·049	·053	·060	·057	·058	·055	·212
Mussooree (2)	...	...	...	...	·034	·037	·040	·044	053	·054	·046	·049	...	...
Chakráta	·051	·050	·050	·048	·040	·039	·051	·047	·051	·056	·053	·050	·049	·190
Leh	·081	·079	·074	·057	·080	·071	·070	·083	·096	·079	·089	·082	·078	·126 ·164

The double barometric tide that occurs regularly every day, especially in tropical countries, is still one of the least understood of atmospheric phenomena. It has been observed at all elevations in the Himálaya to which barometers have been carried, and with no considerable difference of phase,[1] though the range and general form of the oscillation are not the same at different heights. It is thus probably something of the nature of a wave of expansion and contraction propagated upwards and downwards with a velocity equal to that of sound.

The amplitude of the daily tide bears an obvious relation to the diurnal range of temperature, for it is greater over land areas than over the sea, and in table VII. it is seen to decrease pretty regularly from the plains up to stations situated at an elevation of 6,000 or 7,000 feet, where the range of temperature is least, becoming greater again at Leh, where the temperature range is large. Moreover, on the plains there is a well-marked annual variation of the daily range of the barometer, having its maximum in the hot-weather months, when the temperature range is greatest, and its minimum in the rainy season. But the inequality of temperature is not the only cause on which the observed barometric tides depend; for their amplitude, as well as their general form, varies with the season, the latitude and the position of the place with respect to the sea and to mountain ranges.

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[1] Professor Loomis, in the *American Journal of Science* for 1879, finds that at the top of Mount Washington the daily maxima and minima set in three hours later than at the foot, though the difference of elevation between the two stations is only a little over 3,000 feet. This is quite unlike anything that occurs in the Himálaya, and is doubtless due to other causes than those which produce the diurnal tides. Hourly observations made in India show that up to a certain moderate elevation the daily barometric maxima and minima are slightly retarded; but this is due to the mountain winds described below. At Leh, in the upper Indus valley, the diurnal winds cause the morning maximum to occur nearly an hour earlier than on the plains. This will be seen from the following table.—

Place.	Height.	Morning maximum.		Afternoon minimum.	
	Feet.	H.	M.	H.	M.
Calcutta	18	9	35	16	26
Allahabad	307	9	34	16	30
Hazáribágh	2,010	9	17	16	24
Simla	7,071	10	26	16	51
Leh	11,503	8	18	16	29

The observed diurnal movements of the barometric column are in fact made up of several parts, only one of which is directly caused by the alternate heating and cooling which the air undergoes every day, though the others are all indirect effects of it. The direct effect of heating and cooling upon the pressure of the air has been more or less clearly explained by Espy, Davies, and Kreil, but it has not yet been shown by strict mathematical reasoning that their explanation accounts for the whole of the phenomenon. There is firstly, with a rise of temperature in the morning, an increase in the elastic force of the air, indicated by a rise of the barometer. But the increased elastic force immediately sets up a movement of expansion, either vertically or it may be in some cases laterally, by which the pressure is diminished. The actual movement of the mercury in the barometer is determined by the difference of these two actions; and consists of a rise at first, up to 9 or 10 A.M., on the average, followed by a fall which goes on until some time after the hottest period of the day. It is easily seen that as long as the temperature continues to rise more and more rapidly, that is up to 9 A.M. or a little after, the first effect must outweigh the second, and the barometer will rise; but as soon as the rate of increase of temperature begins to grow less, expansion will prevail and the barometer will fall. The expansion will not cease at the instant when the temperature reaches its maximum, but owing to the accumulation of motion it will go on for some time longer. Thus, there ought to be a barometric maximum about the time of most rapidly increasing temperature and a minimum in the afternoon. In much the same way it can be shown that there should be a maximum in the evening, when the temperature is falling most rapidly, and a minimum about the coldest time of the morning.

The coincidence between the barometric minima and the extremes of temperature is usually very far from exact, the barometer in this country standing lowest in the mornings about two hours before the time of minimum temperature, and in the afternoon about an hour and a half or two hours after the hottest time of the day. This may perhaps be explained on the principle of forced oscillations, that in the successive transformations which the energy undergoes, the oscillations approximate more and more nearly to simple harmonic waves with the maxima and minima separated by equal intervals. The diurnal curve of temperature approaches more nearly to a simple wave form than that of the solar radiation which falls upon the earth at any place, and the double daily oscillation of pressure can be almost exactly represented by two waves superimposed.

At most places in India and the Himálaya the minimum temperature of the day occurs about sunrise, that is at 6 A.M. on the average of the year, and the maximum is attained about 2 P.M. The daily rise of temperature therefore occupies only eight hours of the twenty-four, and the fall the remaining sixteen. On the principle that the height of the barometer varies with the rate of change of temperature, the morning maximum should be much more decided than that of the evening; and this is found by observation to be the fact, especially in the interior of India and other continental countries. Over the sea in tropical regions the periods of increasing and decreasing temperature are probably more nearly equal, and there the difference between the day and night waves of pressure is less.

At places near the equator the epochs of maximum and minimum pressure hardly vary from month to month; but in higher latitudes the morning maximum and afternoon minimum approach each other when the days are short, and become more widely separated in the long days of summer.

Besides this primary oscillation of pressure caused by the heating and cooling of the air every day, the barometer indicates other changes due to the transfer of air by winds blowing to and from the place of observation, and perhaps also in some places it indicates other changes again due to the repetition of previous oscillations in the form of free waves. The great regularity and considerable range of the barometric tides over tropical seas where the daily range of temperature is small, may be thus to some extent caused by the repetition of the waves of previous days. In high latitudes, where the days and nights are usually of very unequal length and the variation of temperature is irregular, the tides become feebler, and near the pole disappear altogether, for in forced vibrations of any kind regular periodicity in the cause is an essential condition.

Near the coast the land and sea breezes modify the form of the diurnal pressure curves both at sea and on land. The transfer of air from sea to land during the earlier hours of the night renders the nocturnal fall of pressure on land less, and at sea greater, than it would otherwise be, while the land breeze which blows in the forenoons has a similar effect in the opposite direction. Over the water the morning minimum thus comes to be the lower of the two, in opposition to the usual rule.[1] Among the mountains a very similar semi-diurnal transference of air takes place, causing two distinct types of barometric tides—the one characteristic of valleys and the plains near the mountain system, and the other of high ridges and detached peaks. These types can be readily distinguished in the following table, which gives the variations from the daily mean at the hours nearest the turning points of the tides :—

	4 A. M.	10 A. M.	4 P. M.	10 P. M.
	"	"	"	"
Bareilly ...	—·021	+·060	—·017	+·008
Roorkee ...	—·020	+·057	— 036	—·001
Ránikhet ..	—·025	+ 041	— 018	+·013
Naini Tál ...	—·028	+ 043	—·012	—·003
Chakráta ..	— 022	+ 035	—·015	—·001
Simla[2] ...	—·017	+·063	—·032	+ 022
Leh ...	+ 011	+·037	— 049	+·001

At Bareilly and Roorkee, on the plains, the variation from the mean at 4 P. M. is twice as great as at 4 A. M. At all the Himálayan stations except Leh, which is in a valley between two ridges, this relation is reversed. Over the plains and on the outer hills, as at Naini Tál and Chakráta, the pressure at 10 P. M. hardly differs from the mean of the day. There is a small positive variation for this hour at Bareilly, and as we recede from the mountains and approach the sea the variation becomes greater ; but there can be little error in concluding from the above table that along the southern border of the Himálaya the pressure rises in the evening just sufficiently to touch the mean. At Simla and Ránikhet, some twenty or thirty miles in towards the centre of the mountain system, there is, however, a well-marked evening maximum. This seems to indicate that the air continues to accumulate over the interior of the mountain zone for some time after the current has changed on the outer ranges and the air has commenced to flow back towards the plains.

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[1] Blanford, J. A. S. B., Vol. XLVI., Part II., page 15.

[2] From General Boileau's observations in 1843-45. The daily range given by these figures is nearly twice as great as that of the other stations at the same altitude. The reason is probably some difference in the form of the barometer or in the mode of applying the correction for capillarity.

The transfer of air from the plains to the mountains in the daytime and its retransfer to the plains at night, which, by partly counterbalancing the afternoon fall of the barometer in the mountains and correspondingly increasing it on the plains, cause the peculiarities of the pressure variations seen in the preceding table, are brought about by the expansion and contraction of the air under the influence of heat and cold. In the daytime the air over the plains expands more than that over the hills, because the total thickness of air is greater and the range of temperature is probably higher. The surfaces of equal pressure, which we may assume to be horizontal on the average, are thus raised more above the plains than on the mountains, and the air under the influence of gravity flows down the incline towards the mountains. At night the air contracts and these surfaces sink more above the open plains than in the hills, and there is thus a slope or gradient in the opposite direction.

The following is General Strachey's description of the diurnal variation of the wind in Kumaon :—

"At most seasons of the year we find that on the Himálayan slope winds blow up the valleys during the day, that is from about 9 A. M. to 9 P. M., and down them during the corresponding hours of the night, or from 9 P. M. to 9 A. M. At the debouches of the principal streams into the plains, these night winds blow downwards with great violence, particularly in winter. In the interior of the mountains they are more moderate ; and at great elevations, and in the central parts of Tibet, the nights are almost always nearly calm. The diurnal currents from the south, on the other hand, increase in force as we ascend in height ; and along the Indian watershed and the neighbouring parts of Tibet they are excessively strong ; so that in travelling there, I have often looked forward to the afternoon, when they are at their height, with real dread ; and the natives of the country invariably endeavour to cross the high passes of the Indian watershed early in the day, for the purpose of avoiding the fury of the afternoon wind. As we advance further into the tableland, however, their power rapidly ceases.

"These winds, though on the whole blowing from the south-west during the day and from the north-east at night, that is perpendicular to the general line of the mountains, are naturally constrained to follow the course of the deep valleys up which they pass, so that their direction is subject to endless local variation ; and, excepting on the tops of the hills, little information can be obtained by a register of the direction of the wind on the Himálaya, beyond the fact of there being an up or down current. In the part of Tibet I visited, near the Indian watershed to the north of Kumaon, the day wind seemed to commence in the south-east quarter about 9 A. M., and gradually to shift round with the sun as the day advanced, ending in the south-west quarter about 9 P. M. On several occasions in these localities I also noticed the wind blowing faintly from the north early in the morning. * * * * * * * * * *

"The calm nights of the table-land and the higher mountains would (according to the theory above stated) be a consequence of their position in the centre of the mountain area, where the down current would originate, and therefore have the least force, though it be still felt in the faint northerly winds that are often observed near the Indian watershed.

"The violent night winds from the gorges by which the principal rivers leave the mountains would not appear to be altogether due to the same cause which produces the ordinary down winds, but to the accumulation of cold air in the deeper valleys to which I have before alluded. The air collected in these aërial lakes, as they may be called, having no means of escape but the openings through which the drainage is carried off, pours from them in a current the velocity of which will be dependent on the depth and area of the mountain basin from which it flows."

General Cunningham also states that in Ladák and Spiti the southerly or south-westerly day wind usually begins about 9 A. M., the wind blowing faintly from the north about midnight and from the north-east in the early morning.

The day and night winds are probably strongest about 4 P. M. and 4 A. M., and the pressure and temperature observations made at these hours on the plains and at the hill stations indicate clearly enough that the direction of the baric gradient is from the plains towards the mountains in the afternoons, and from the mountains towards the plains in the mornings. When the pressures of Roorkee and Bareilly at 4 A. M. are reduced to the level of Chakráta and

Ránikhet respectively, and are corrected for any residual gradient to or from the mountains discovered by similarly reducing the mean pressures to the level of the hill stations, it is found that there is a pressure difference of ·077″ at Chakráta and ·055″ at Ránikhet, sending a wind towards the plains. At 4 P. M. the gradient is towards the hills, and is equal to ·062″ at an elevation of 7,000 feet between Roorkee and Chakráta; while between Bareilly and Ránikhet it is equal to ·045″ on the average of the year. On the southern border of the mountain zone the gradient causing the down wind at night is therefore rather greater than that which causes the up wind during the day.

When the pressures of Roorkee at 4 A. M. and 4 P. M. are reduced to the level of Leh, a station beyond the Indian watershed, the gradients are found to be ·033″ in the morning and ·182″ in the afternoon. The pressure difference causing the day wind at great elevations thus appears to be nearly six times as great as that which causes the night wind; but this relation is much exaggerated, no doubt, by the peculiar form of the pressure variation at Leh, which cannot be taken as a typical mountain station. This peculiar variation is doubtless due to the position of Leh in a narrow valley between two parallel mountain ranges. In the daytime the air of the valley expands and flows towards the mountains, and at night it again accumulates over the valley. In this way the nocturnal barometric tide is completely obliterated, and the afternoon fall of the barometer is rendered much greater than it would be on an open plain at the same altitude.

In April, May, and June the afternoon winds of the mountains blow with greatest violence, because in these months the range of temperature both on the plains and among the mountains is greatest. In these three months we find the afternoon fall of the barometer on the plains at a maximum, while at the hill stations it is less than in the cold weather. The nocturnal inequality of pressure is then at a minimum on the plains and valleys and at a maximum on the hills.

The annual variation of pressure differs from the diurnal in that no part, or an exceedingly minute part, of it is due to direct increase or decrease of elastic force accompanying gain or loss of heat. The rise of temperature in the first half of the year and the fall in the latter half are accomplished so slowly that the increase or decrease of elastic force cannot accumulate, but is lost in expansion or contraction. The annual variation is thus almost entirely a secondary effect due to the movement of air both vertically and horizontally. When the temperature of the air over India changes the air expands or contracts, and the hypothetical surfaces of equal pressure widen out or come closer together than they were before; and since the annual variation of temperature over the south of India is very small in comparison with that which occurs over the northern plain and in Central Asia, the vertical range through which these surfaces travel in the course of a year will be greater on the Himálaya than under the equator. In the cold weather, for example, the planes of 30, 29, 28, &c. inches are wider apart vertically over Ceylon than in Northern India, while at the end of the hot and in the rainy season the opposite relation obtains.

If there were no lateral movements of the air the pressure at a station on the plains would be nearly constant all the year round, while at the hill stations it would be least in winter and greatest in summer, because in the latter season a larger fraction of the total atmosphere than usual would be elevated above the place, while in the winter less than usual would lie above it. In winter, however, the planes of equal pressure in the upper regions of the atmosphere over India all slope towards the north, and down this slope winds blow, causing an accumulation of air over Northern India which renders the total pressure observed on the plains at that season greater than in summer. As regards mountain stations, it depends entirely on the height of the place whether the influx of air from the south will be more or less than sufficient to compensate for the contraction and sinking of the atmosphere in winter. At all the hill stations in Table VI. above 5,000 feet elevation there are indications of a winter minimum of pressure, though this is not the lowest minimum except at Leh, the most elevated station of all. There the pressure is least in the beginning of February, whereas at all the other stations, as on the plains, it is least in June and July.

During the cold weather winds are usually blowing out from Northern India towards the south along the surface of the ground at the same time that other currents are blowing northward in the upper strata; the apparent direction being modified in either case by the rotation of the earth on its axis and by friction against the ground surface. On the plain of the Ganges the conformation of the surface makes the lower winds have a north-westerly direction.

As the temperature rises the air over India expands and a larger and larger proportion of the total atmosphere is lifted above the level of the hill stations. In consequence of this the barometer at first rises at the higher hill stations; and it simultaneously sinks over the plains and the lower hills owing to the outward movement of the air. As the season advances more and more air is removed from India by the strong day winds which blow in the hot weather as well as by the winds over the Indian watershed that have been already described, while but little is restored by the feeble night winds that come from the opposite quarters; the barometer continues to fall over the plains, and the rise observed at the hill stations in spring is soon also changed to a fall, except at Leh, where the barometer continues rising until May. In the upper half of the atmosphere, that is, above the plane of 15 inches pressure, the summer depression of the barometer, which at Leh is feebler than that of winter, probably disappears altogether, and the barometer stands highest in the hottest season as it would do at all elevations if there was no transfer of air from place to place by lateral currents or winds.

When the temperature of Northern India is at its maximum in the latter half of June, the planes of equal pressure are widest apart, and they all slope towards the north in the lower half of the atmosphere. Winds consequently blow in from the sea towards the land in the lower strata, and there are possibly upper currents in the opposite direction, though the existence of such has not yet been established. This relation continues until the autumnal equinox, after which the temperature falls rapidly, and the atmosphere contracts and sinks so as to reproduce the conditions characteristic of the cold weather. The cooling of the air at this season, like the heating of it in spring, produces a differential effect on the height of the barometer at the hill stations, which again have a maximum of pressure in November.

When the effects of the two actions above described—the expansion and contraction of the atmosphere vertically, and the lateral transference of air by winds—are borne in mind, some curious and at first sight inexplicable peculiarities of the annual variation of pressure become intelligible. For example, on the plains the barometer almost invariably stands higher in December than in January, though January is the colder month of the two. This anomaly at once disappears when we remember that the total pressure of the air on the plains, considered statically, is made up of two parts—that of the air from the plains up to the hill stations, and that of the air lying above the hill stations. The latter part appears from the observations of Leh to be greatest in the first fortnights of May and November, and least in the corresponding parts of February and August; and if the monthly means for any station on the plains or lower hills be subjected to harmonic analysis, the annual variation will be found to be very closely represented by two harmonic waves—one of annual period, reaching its maximum at the time of greatest cold in the beginning of January, and the other of six months' duration nearly coinciding in phase with the pressure variation at Leh. The amplitude of the first of these undulations, which is as much as six tenths of an inch at some places on the plains, rapidly diminishes as we ascend, and passing through a zero value at about 10,000 feet elevation, re-appears at Leh in nearly the opposite phase, the minimum falling in winter. The amplitude of the half-yearly oscillation increases slightly as we ascend, but it appears to vary with distance from the plains in a horizontal direction rather than with height. The observed pressure on the plains, being due to the superposition of the two waves, is highest in December—that is, between the dates when each wave separately attains its maximum.

The truth of this theory of the annual change of pressure may be more clearly seen from Table VIII., where the monthly variations of the barometric weights of three successive strata of the lower atmosphere from their annual mean values are compared with the simultaneous variations of temperature. The last double column gives the variations for the whole thickness of the atmosphere from the plains up to 11,500 feet above sea-level.

VIII.—Annual variation of pressure and temperature in the lower atmospheric strata over the Himálaya.

Month.	*Roorkee to Dehra,* 1,345 *feet.*		*Dehra to Chakráta,* 4,820 *feet.*		*Chakráta to Leh,* 4,431 *feet.*		*Roorkee to Leh,* 10,616 *feet.*	
	Temperature variation.	Pressure variation.	Temperature variation.	Pressure variation.	Temperature variation.	Pressure variation.	Temperature variation.[1]	Pressure variation.
	°	″	°	″	°	″	°	″
January	−17·0	+·067	−15·3	+·131	−18·2	+·092	−18·2	+·290
February	−13·2	+·046	−12·6	+·125	−14·9	+·079	−14·5	+·250
March	− 4·6	+·014	− 5·3	+·045	− 7·5	+·040	− 6·4	+·099
April	+ 6·0	−·018	+ 4·4	−·029	+ 2·1	+·026	+ 3·6	−·021
May	+12·3	−·040	+ 9·9	−·075	+ 7·3	−·037	+ 9·6	−·156
June	+14·9	−·052	+13·0	−·131	+13·0	−·080	+14·0	−·263
July	+10·0	−·040	+ 8·9	−·119	+14·7	−·066	+13·3	−·225
August	+ 8·8	−·030	+ 8·2	−·099	+13·0	−·045	+11·7	−·174
September	+ 7·3	−·020	+ 6·7	−·073	+ 8·7	−·032	+ 8·4	−·125
October	+ 0·2	−·001	+ 0·5	·000	− 0·1	+·008	+ 0·2	+·007
November	− 9·0	+·029	− 6·1	+·092	− 6·4	−·001	− 7·5	+·120
December	−15·9	+·048	−12·0	+·131	−11·3	+·023	−14·0	+·202

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[1] From the average of the three stations—Roorkee, Chakráta, and Leh.

The barometric weight of each stratum and of the whole thickness—that is, the difference between the observed pressures at the top and bottom—varies inversely with the temperature, and the one variation is as nearly as possible proportional to the other. The only exception worth noting is that in the month of November the statical pressure of the stratum between Chakráta and Leh is less than it should be according to the temperature figures. This anomaly, however, would probably disappear from the means of a longer series of observations.

The annual variation of the wind in Northern India is for the most part such as should accompany the pressure variations above described, according to the usually received "convection current" theory; but there is one important feature of the winds of the plain that has not yet been satisfactorily explained—namely, the prevalence during the hot weather of strong north-westerly winds when the distribution of temperature and pressure should, by the theory of convection currents, give rise to winds with a southerly element. These "winds of elastic expansion," as they have been called by Mr. Blanford, actually blow sometimes from places where the mean pressure is low to others where it is slightly higher. They are the strongest winds of the year on the Indian plain; they blow only in the daytime, and since there is no compensating current of any appreciable strength at night, they are probably the chief agency in that removal of air from Upper India which causes the great summer depression of the barometer. They are not confined to India, but are equally characteristic of Afghanistan; and Colonel Prejevalsky encountered winds perfectly similar in everything except temperature in various parts of the Gobi desert and on the Alashán plateau north-east of Tibet. On the southern slope of the Himálaya these winds are sometimes met up to elevations of 6,000 or 7,000 feet, and when they blow the air is unusually dry and full of dust. At greater elevations, however, they are either not felt or become undistinguishable from the ordinary up currents that blow during the day.

IX.—Mean resultant wind directions at places in the Himálaya.

Place	January	February.	March.	April.	May.	June	July.	August.	September.	October.	November.	December.	Number of years.
Bareilly .	N.57°W.	N.54°W.	N.56°W.	N.56°W.	N.82°W.	N.85°E.	S.66°E.	S.64°E.	N 81°E.	N.62°W.	N.54°W.	N.65°W.	9-12
Roorkee ...	N.71°W.	N.51°W.	N.76°W.	N.78°W.	S.21°W.	S 6°E.	S 40°E.	S.34°E.	S.	S.30°E	S.18°E.	N.74°W.	10-13
Dehra ...	S.72°W.	S.67°W.	S 79°W.	S.74°W.	S.58°W.	S 66°W.	S 67°W.	S 56°W	N.61°W.	N.64°W.	N.75°W	N.89°W	9-10
Dharmsála ...	S.71°W.	S.73°W.	S.80°W.	S.69°W.	S.59°W.	S.66°W.	S.71°W.	S.71°W	S 57°W.	S.66°W.	S.52°W	S.59°W.	4-5
Ranikhet ...	S.81°W.	S.54°W	S.57°W.	S.65°W.	S.63°W.	S 75°W.	S.77°W.	S.72°W.	S.61°W.	S 53°W.	S.50°W.	S 60°W.	7-10
Naini Tál ...	S.19°E.	S.39°E.	S.	S.57°E.	S 49°E.	S.40°E.	S.11°E.	S.44°E	S.44°E.	S.41°E.	S 38°E.	S.41°E.	7
Chakráta ...	S.69°W.	S.19°E.	S.	S.59°W.	S.55°W	S.74°W.	S 51°W.	S.55°W.	S 50°W.	S.28°W.	S 29°W	S.18°W.	6-10
Leh ...	S. 8°W.	S.11°W.	S.28°W.	S.22°W.	S.40°W.	S.52°W.	S.57°W.	S 33°W.	S.29°W.	S.37°W.	S 27°W.	S.17°W.	4

From the preceding table it is seen that though the change of the prevailing wind from north-west to east or south-east at the commencement of the rains is very distinctly marked on the plains, no such change takes place at the hill stations. Even at the lowest of these, Dehra, the resultant wind varies only from about three points north to the same distance south of west. At all the higher stations the prevailing direction in every month is southerly or south-westerly, with modifications depending on the form of the ground,—at Naini Tál, for instance, the winds are generally south-easterly. The only notable variation of the wind direction is a deflection towards the east at Chakráta (also at Simla, Marri, and *other stations on the north-western Himálaya) at the time* when the winter snows and rains are heaviest. The cause of this has not yet been ascertained.

The wind direction at the hill stations changes so little from month to month because the winter monsoon is of no great vertical thickness, while that of the summer months extends to a much greater elevation than the highest station at which observations have been made. When northerly or north-westerly winds are blowing on the plains, the return current from the south-west is felt on the mountains at all elevations above the first few thousand feet; and when southerly winds blow over the plains, the return current, if it exists at all, lies at a very great altitude. The existence of this return current from the north during the summer monsoon may possibly be proved by cloud observations. Dr. Scully's observations on the way back from Yarkand in August, 1875, tell neither for nor against it, the resultant of all the wind directions observed at elevations above 14,000 feet being due west.

In the next table the vertical thickness of each monsoon current on the Himálayan slope has been computed approximately from observations made at pairs of hill stations in the north and south of India. The northern stations are Roókee and Chakráta, and the southern ones, Colombo and Newara Eliya in Ceylon. To render the figures directly comparable, the observed pressures at the hill stations have been reduced to the common elevation of 7,000 feet, and those of the lower stations to sea-level, as was done by Mr. Blanford in drawing up a similar table in the *Indian Meteorologist's Vade Mecum*, page 175.

X.—Vertical thickness of the Monsoon Currents.

Season.	Month.	*Mean pressure at 7,000 feet.*			*Mean pressure at sea-level.*			*Neutral plane.*	
		Ceylon.	Dehra Dun.	Gradient sending wind towards north.	Ceylon.	Dehra Dun	Gradient sending wind towards north.	Approximate pressure.	Approximate elevation in feet.
		″	″	″	″	″	″	″	
Winter.	November .	23·388	23·353	+ ·035	29·904	30·021	−·117	24·15	5,780
	December ...	23·387	23·337	+ ·050	29·911	30·078	−·167	24·89	5,260
	January ...	23·379	23·310	+ ·069	29·915	30·070	−·155	25·39	4,690
	February ..	23·389	23·270	+ ·119	29·917	29·994	−·077	27·35	2,650
Summer	June ...	23·348	23·179	+ ·169	29·856	29·483	+ ·373	17·96	14,130
	July ..	23·343	23·160	+ ·183	29·874	29·508	+ ·366	16·81	15,930
	August ..	23·344	23·205	+ ·139	29·879	29·576	+ ·303	17·80	14,370
	September ..	23·359	23·270	+ ·089	29·897	29·681	+ ·213	18·67	13,140

At 7,000 feet elevation the pressure gradient in both seasons is such as to send a current from south to north, while at sea-level it is only in the winter season that the wind blows from north to south. The neutral plane separating the lower wind current from the supposed upper return current is nearly 16,000 feet above the sea in the height of the rainy season; but in the cold weather, especially in January and February, the neutral plane is below the level of the hill sanitaria.

The heights in the table represent only the approximate mean positions of the neutral plane for the several months. In reality its height is constantly fluctuating, and thus in the winter season it often sinks so low as to strike the Indian plain below the base of the hills. A moist easterly or south-easterly current then blows for several days at a time in Upper India, bringing the winter rains, while in Southern India the wind may be northerly. The *prevailing* direction of the wind on the plains is, however, always northerly in the cold weather, in accordance with the mean position of the neutral plane.

The pressure gradients both at sea-level and at 7,000 feet are much greater in summer than in winter. In the latter half of October and the beginning of November there is hardly any gradient either way, and at that time feeble winds and calms prevail. The velocity of the wind being directly proportional to the baric gradient (except perhaps in the case of anomalous currents like the "winds of elastic expansion" which blow down the valley of the Ganges in the hot weather), this velocity should be greater in the rainy season than in winter.

XI.—Monthly mean velocity of wind in miles per diem.

Station	January.	February.	March.	April.	May.	June	July.	August.	September.	October.	November.	December.	Year.
Roorkee,	55·8	65·9	67·3	74·6	91·9	101·0	18·3	65·5	58·8	35·8	31·3	35·7	63·5
Bareilly,	70·6	95·1	95·1	110·1	117·2	131·5	105·5	75·9	71·8	41·0	42·3	51·6	81·3
Dehra ..	40·1	19·2	57·6	65·2	61·7	51·0	31·9	29·6	31·1	12·6	50·9	47·1	17·3
Ránikhet,	71·9	77·0	87·1	131·3	98·0	120·0	129·1	150·3	136·1	116·8	99·5	95·0	109·1
Chakráta,	111·5	111·6	129·1	137·0	135·8	128·1	110·1	88·5	100·3	116·1	105·9	103·3	117·7

Table XI. shows that on the plains and at Ránikhet (for which station more observations are required to get a good average) the wind velocity is least in winter, but that at Chakráta it is least in the rains. At the hill stations the winds are chiefly of the diurnal kind, and are feeblest when the temperature range is least—that is, in the month of August.

Humidity and cloud.

The quantity of water vapour present in the air at any time is a most important meteorological condition. It depends on the temperature, the distance from the sea or other evaporating surface, and the direction of the wind. These relations are very distinctly marked on the North Indian plain, where the high temperature range in the yearly period and the semi-annual change of the winds combine to render the proportion of vapour in the air during July and August nearly three times as great as in December and January. A high temperature cannot of course increase the quantity of vapour in the air, unless it be in a region where vapour is being generated. Accordingly we find in Table XII. that the vapour pressure at Roorkee, on the drier part of the plain, hardly varies from December to April, though as soon as the sea winds set in, which they sometimes do in the middle of May, the proportion of vapour rapidly increases. At Bareilly, where the surrounding country is moister and better wooded than at Roorkee, there is a slight increase of vapour in the hot-weather months.

XII.—*Monthly mean tension of aqueous vapour at places in the Himálaya.*[1]

Place.	Elevation in feet.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	Number of years.
		"	"	"	"	"	"	"	"	"	"	"	"	"	
Bareilly	568	·334	·353	·413	·456	·570	·751	·953	·939	·866	·610	·422	·351	·585	11-12
Roorkee	857	·310	·338	·362	·360	·460	·677	·902	·903	·820	·543	·368	·324	·531	12-13
Dehra	2,232	·294	·325	·372	·418	511	·721	·881	·878	·794	·521	·356	·301	·531	12-13
Dharmsála	4,495	·271	·281	·352	·439	·459	·539	·643	·627	·601	·444	·294	·274	·436	4-5
Mussooree	5,830	·202	·206	·219	·280	·322	471	·643	·620	·621	·402	·281	·240	·378	1-3
Ránikhet	6,069	·190	·203	·235	·264	·341	·472	·597	·598	·536	·354	·253	·199	·353	6-7
Chakráta	7,052	·177	·191	·222	·265	·332	·455	·583	·582	·519	·344	226	·187	·340	8-11
Kumaon and Garhwál[2],	8,000 to 9,000	...	·140	·220	...	...	·400	...	...	...	·280	...	...	?	...
Ditto	9,000 to 10,000	...	...	...	...	...	·420	·	...	...	·250	...	...	?	...
Ditto	10,000 to 11,000	...	...	...	...	...	·310	·350	...	...	·330	...	...	?	...
Leh	11,538	103	·120	·134	·142	·167	·217	·339	·313	·246	·144	115	·093	·177	4
Kumaon and Garhwál[2],	12,000 to 13,000	...	...	...	...	...	·210	·250	320	...	...	...	...	?	...
Ditto	13,000 to 14,000	...	...	...	...	...	..	·200	...	...	...	...	...	?	...
Ditto	14,000 to 15,000	...	...	...	...	...	...	·140	·210	·200	·120	...	...	?	...
Ditto	15,000 to 16,000	...	...	...	...	...	...	·140	·130	·110	...	...	...	?	...
Ditto	16,000 to 17,000	...	...	...	...	...	...	·120	·180	...	...	...	. .	?	...
Ditto	17,000 to 18,000	...	...	...	...	...	...	·130	...	...	...	...	...	?	...
Ditto	18,000 to 19,000	...	...	...	...	...	...	·120	·150	...	...	...	...	?	...

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[1] These are the means of observations at 10 A. M. and 4 P. M. There is a certain diurnal variation of vapour tension but its range is very small and it varies a good deal at different places. For most of the stations in the table the correction for this variation is unknown, and therefore all the figures have been given uncorrected.

[2] From miscellaneous observations by General Strachey.

The tensions in the foregoing table have been computed from observations of dry and wet bulb thermometers. The formula used for the most part has been Apjohn's; but all the figures for Leh and Musooree, and those for the last four years at the other stations, have been computed by means of certain tables based on August's formula.

On the southern slope of the mountains the annual variation of vapour tension is similar to that which obtains on the plains, though because of the considerable evaporation from the forest-covered slopes, and the occasional showers of rain which fall, the increase of vapour during the hot weather goes on much more uniformly than on the plains. At Leh, where hardly any precipitation occurs at any time of the year, but in the neighbourhood of which there is some cultivated land irrigated from the hill streams, the annual variation of vapour tension is determined almost entirely by the temperature. In the valley of Yárkand the quantity of vapour in the air is similarly determined by the temperature and the extent of irrigation.

In the mountains the mean vapour tension decreases very rapidly with the height, on account of the rapid decrease of temperature as we ascend. If Dalton's law, that in a mixture of gases or vapours the pressure of each is the same as if it filled the whole space alone, were applicable to the atmosphere, as is sometimes supposed even yet, then the pressure or tension of vapour observed on the plains ought to be reduced one-half on ascending through 20,000 feet; but it is found by observation that a vapour pressure equal to half that observed on the plains is attained at an elevation of 7,000 or 8,000 feet. This was pointed out by General Strachey in the *Proceedings of the Royal Society* for March, 1861, where he has shown that the observations of Mr. Welsh in balloon ascents, those of Dr. Hooker in Sikkim, and his own observations in Kumaon (most of which are included in Table XII.), make it perfectly certain that the proportion of water vapour which exists at any given elevation is determined, not by Dalton's law, but simply by the temperature. The vapour raised from the earth's surface is constantly diffusing upwards, and would go on doing so until it attained the state of equilibrium represented by Dalton's law; but the temperature falls so rapidly as the height increases that saturation point is reached and the vapour is partially condensed into cloud or rain long before the barometric equilibrium is attained.

In the third column of Table XIII. the figures given in the previous table have been compared in a manner suggested by Strachey. The tension of vapour at sea-level under Kumaon and Garhwál has been computed for each month, by multiplying the mean of the observed tensions at Roorkee and Bareilly into the ratio between the tension of saturated vapour at the sea-level temperature and that of saturated vapour at the temperature of the plain; that is to say, the temperature is supposed to be corrected for elevation above the sea while the degree of saturation remains constant. The figures in Table XII. have then been divided by the corresponding tensions at sea-level, and the average of the fractions for all the months has been calculated for each elevation. Finally, from these results the ratio of the tensions at each even thousand feet above the sea has been found by interpolation. The second column of the table gives the results of Sir Joseph Hooker's observations in Sikkim compared with those taken at the meteorological observatory of Gwálpara near the foot of the hills, and the fourth column has been computed from the observations in General Cunningham's *Ladák* and those taken by Dr. Scully on the way back from Yárkand in 1875. The latter have been published in the *Indian Meteorological Memoirs*, No. VIII. The base station for the Kashmir group is Ráwal Pindi. The figures opposite 7,000 feet in the second and fourth columns are derived from the monthly means of the Darjiling and Marri observatories.

XIII.—Proportions of vapour tension at various elevations in the Himálaya.

Height.	*Sikkim.*	*Kumaon.*	Kashmir *and* Ladak.	MEAN FOR HIMÁLAYA.		
				Observed.	Computed by Strachey's method.	Computed by Hann's method.
Sea-level ..	1·00	1·00	1 00	1·00	1·00	1·00
1,000 feet ..	·89	·92	·92	·91	91	·91
2,000 „ ...	83	89	·85	86	·83	·82
3,000 „ ...	·71	·87	·69	·77	·75	74
4,000 „ ...	·67	·74	52	64	·68	·67
5,000 „ ...	·61	·70	·51	62	·62	·61
6,000 „ ...	·59	·60	·57	·59	·56	·55
7,000 „ ...	53	·56	·60	·56	51	·50
8,000 „ ...	50	·53	44	·48	·46	·45
9,000 „ ...	·44	·49	— 28	40	42	·41
10,000 „ ...	40	·47	27	38	38	·37
11,000 „ ...	·37	·35	·26	33	34	·33
12,000 „ ...	·35	·28	·21	·28	·31	·30
13,000 „ ...	·30	25	·23	·26	28	·27
14,000 „ ...	·27	·20	·19	·22	·25	·24
15,000 „ ...	·27	17	15	·20	·22	·22
16,000 „ ...	·22	·15	·16	·18	·20	·20
17,000 „ ...	·20	·15	·14	·16	·18	·18
18,000 „ ...	·19	·14	·15	·16	·16	·16
19,000 „ ...	18	·13	·14	·15	·14	·15

The mean of all three sets of observations probably represents very closely the actual diminution of vapour pressure on ascending in the Himálaya. It decreases with more regularity than either the Kumaon or Kashmir series of observations alone, and it agrees very closely with the series for Sikkim, where the relative humidity, or percentage of saturation, varies much less than in the western Himálaya. The last column of the table but one gives a series of ratios calculated on the assumption that the degree of humidity is the same at all elevations, and that the temperature of the southern slope of the Himálaya decreases at the mean rate above found—one degree in 361 feet. This series agrees very closely with the average of the results given by observation ; though from 2,000 to 10,000 feet the calculated ratios are all considerably less than those observed in Kumaon. During the hot-weather months the degree of saturation on the plains below Kumaon falls exceedingly low, while on the hills, as has already been stated, the air remains much moister ; at Dehra, for example, the vapour pressure in March, April, May, and June is greater than at Roorkee owing to local evaporation. Thus on the average of the year the relative humidity of the air in the Kumaon hills is considerably greater than over the plain. On the other hand, the observed ratios from 14,000 feet upwards are less than those given by calculation, because most of the observations at those altitudes were made at places lying behind the snowy range.

In the last column are given the ratios calculated by the logarithmic formula, $\log p = \log \mathrm{P} - \frac{h}{23058}$, where h is expressed in feet. Dr. Julius Hann, in an article in the Austrian Meteorological Society's Journal for 1874, page 193, has deduced from all the available observations on mountains and in balloons a similar formula in which the numerical constant is 6,517 metres, or 21,382 feet. On the assumption that this formula holds good to some distance beyond the limits of observation, we find that an elevation of 23,000 feet, or about the average height of the snowy peaks, the quantity of vapour in the air is only one-tenth of the quantity at sea-level. The extreme dryness of Tibet and Ladák is thus easily accounted for.

The logarithmic formula has the advantage of enabling us to calculate approximately the total quantity of vapour in the air at any time, by an application of the integral calculus. Using the generally received values for the density of water vapour and its co-efficient of expansion with heat, and extending the integration to an infinite height above the ground, it is found that the depth of water that would be formed by the complete condensation of the vapour over a given area is almost exactly three times the height of the mercurial column which measures the pressure of the vapour at the bottom. In the rainy season for example, when the pressure of vapour over the Indian plain is equal to about an inch of mercury, the complete precipitation of the vapour would yield only three inches of rain, that is, less than the quantity which sometimes falls in two or three hours. A continuous downpour amounting to fifteen or twenty inches, such as frequently occurs in India, must be fed by a powerful indraught of moist air.

The relative humidity of the air is probably greater at all elevations on the Himálayan slope than either on the plains or on the Tibetan plateau beyond the Indian watershed; and it is doubtless greater on forest-clad slopes and valleys than on steep and bare mountain sides. On a high ridge, too, which intercepts and deflects upwards the prevailing south-west winds, thereby cooling them and partially condensing their vapour, the degree of saturation is greater than on the lower ridges or valleys behind it; for the air in sinking after crossing the high ridge is warmed and rendered capable of absorbing more moisture than it has been able to retain in crossing the ridge. Thus Naini Tál, independently of the influence of the lake, is always much moister than Ránikhet or the notoriously dry and bare station of Almora. The registers of the meteorological observatories do not, however, illustrate this very well; for at several of them observations have only been taken in the daytime, when the relative humidity is below the mean; and the humidities recorded at the old observatory of Naini Tál are quite untrustworthy and in many cases impossible. At Bareilly, Roorkee, Ránikhet, and Chakráta observations were taken both night and day for some years, at the hours of ten and four. If the means of the four observations at these hours be adopted as daily means, Chakráta appears to be the most humid of the four stations, and Roorkee and Ránikhet the driest, though the difference between Chakráta and Roorkee or Ránikhet is less than might be anticipated. The humidities of the other places in Table XIV. have been calculated approximately from the monthly means of temperature and vapour tension. The figures for Leh in the winter months are doubtful; the psychrometer generally giving unreliable results when the temperature falls much below freezing.

XIV.—Approximate mean humidities of places in the Himálaya.

Place	January.	February	March	April.	May.	June.	July.	August.	September.	October	November	December.	Year.
Bareilly ..	69	63	51	39	43	59	82	83	81	70	65	69	65
Roorkee ...	69	65	53	36	37	54	78	80	77	65	62	68	62
Dehra ...	69	69	58	47	45	63	86	90	86	69	62	67	70
Dharmsála ..	83	73	67	57	51	55	79	80	77	69	56	67	68
Mussooree ..	66	64	53	45	49	62	99	99	98	70	61	72	70
Ránikhet ..	60	58	52	39	49	61	85	86	79	60	53	54	62
Chakráta .	68	61	56	49	57	68	91	94	89	61	49	58	67
Leh .	100	100	79	57	52	50	62	66	68	63	67	71	70

The relative humidity of the air at all elevations up to 11,500 feet is subject to a double annual variation, one maximum occurring at the time of greatest cold, and the other in the middle of the rainy season. At Leh the summer maximum is very faintly marked, nine-tenths of the vapour brought by the south-west monsoon being cut off before reaching the station, and at Dharmsála, north of the Panjáb, the air appears to be slightly more humid in winter than in summer. At all the other stations the maximum degree of humidity is reached in August.

In April and November the air is dry, especially in the former month, when, during hot winds from the north-west, the percentage of saturation over the plains often falls as low as 5 or 6. In the hills, at Almora and Ránikhet, the humidity of the air frequently sinks to 25 per cent., but is seldom less than 20 per cent. The month of November and the beginning of December appear to be quite as dry as April at the higher hill stations, where these months are rainless, while showers sometimes fall in April; but on the plains, because of the low temperature of November and the moisture left in the ground by the summer rains, the air is still comparatively moist. In the cold weather the Sub-Himálayan stations are more humid than the hill stations on the average of the twenty-four hours, probably because the air, which is cooled and has its relative humidity increased by radiation *during the night, drains away* from the hills and collects over the plain. At this season the air at the hill stations appears to be drier in the mornings than in the evenings.

The humidity of the upper regions of the atmosphere, as indicated by clouds, is always greater in the daytime than at night. On the outer slope of the Himálayan chain the variation is doubtless quite as distinctly seen as anywhere else in the world, but it has not been recorded in the observatory registers, where only the amounts of cloud seen at 10 A.M. and 4 P.M. have been entered. The variation is, however, probably very similar to that which occurs over the plains, where the sky is most serene about 10 P.M. and most cloudy at the hottest time of the day, when the upward convection currents are strongest. In Table XV. the figures represent the means of the 10 A. M. and 4 P. M. observations, and they are therefore a little above the true mean for the day.

XV.—Average proportion of cloudy sky in tenths of the expanse.

Station.		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Bareilly	...	2·87	3·12	2·97	1·96	1·46	3·98	7·11	6·18	4·50	0·73	0·72	1·85	3·12
Roorkee	...	2·96	3·47	3·12	2·25	1·71	2·90	4·07	4·50	4·58	0·99	0·82	2·18	2·87
Dehra	...	3·73	4·07	3·55	2·50	2·75	4·02	7·50	7·00	4·83	1·08	1·33	2·74	3·76
Dharmsála	...	4·99	3·91	3·42	2·17	2·60	3·26	7·60	6·76	4·09	0·74	0·95	2·02	3·54
Ránikhet	...	3·66	4·42	3·78	3·34	3·58	5·41	8·58	8·42	5·61	1·69	1·31	2·99	4·10
Chakráta	...	4·23	4·75	4·41	3·12	3·75	5·14	8·89	8·57	6·79	2·28	1·71	3.62	4·80
Leh	...	6·32	6·38	6·27	5·78	5·77	5·50	4·89	4·68	4·11	4·19	5·12	5·91	5·44

The annual variation of cloud is similar to that of the relative humidity of the air near the ground. It has two maxima, in the cold weather and the rainy season, and two minima, in April or May and in November. April is cloudier than November, probably because the upward movement of the air during the day then prevails over the downward movement at night, while in November the prevalent movement is downward. In this way the air in the upper strata is dynamically cooled in the hot-weather months and dynamically heated in November. The variation of humidity at the hill stations is intermediate in character between that observed on the plain and the variation in the cloud-bearing strata of the atmosphere.

No direct observations of the heights of clouds above the ground have been made in the Himálaya. The ordinary clouds of the rainy season that look like broken cumulus from below are often not more than 5,000 or 6,000 feet above sea-level, hill stations like Naini Tál and Mussooree being frequently enveloped in them for days. They sometimes even extend down to the level of the plains, the whole mass of the mountains up to the snows being then shrouded in fog. From the vapour tensions given in Table XIII., and the temperature decrements in Table V., it is possible to calculate approximately the average height at which a mass of air rising up from the plain would reach the dew-point and begin to form cloud. In January this height is a little over 4,000 feet above the plain, or about 5,000 feet above sea-level. In April and May the height above the plain is 8,000 feet, and at this time of the year it is rare to find clouds resting on the outer ridges of the Himálaya, though great banks of them are formed every day along the southern face of the snowy range. In the rainy season, that is, between the middle of June and the end of September, the average height at which clouds would commence to be formed in a rising column of air is 3,100 feet above the plain or about 3,900 above sea-level. This probably coincides very nearly with the zone of greatest rainfall on the mountains. In August, when the air is most humid and rainfall most frequent, the average lower limit of cloud is probably about 3,200 feet above the sea.

Regarding the upper limit of cloud nothing is known. The light feathery ice-cloud called cirrus, seen above the plains of Tibet and the passes over the Indian watershed, appears quite as high as when viewed from the Indian plain. It is probably formed at all elevations to which water vapour extends, though what the upper limit of vapour is we do not know. If we assume the cirrus clouds over the Tibetan plateau to be twice as high as the plateau itself, say 30,000 feet above sea-level, the quantity of vapour in the air would be only one-twentieth of that observed on the plains of India, but it would probably be quite sufficient to form light clouds.

Rain and snow.

The distribution of rain both on the plains and on the mountains has already been described in a general way. The plains of Northern India, between the mountains and the Jumna river, or a line drawn north-westward from Delhi beyond the river, may be divided into roughly parallel zones of equal rainfall, that which receives the greatest amount of precipitation lying nearest to the Himálaya. The breadth of each of these zones gradually diminishes towards the north-west and widens out in the direction of Bengal, because, the prevailing wind of the rainy season being easterly over the plain, the supply of vapour gradually diminishes and the rains become lighter as we pass from east to west. In Table XVI., the average monthly rainfalls of 15 places on the plains near the base of the hills of Kumaon, Garhwál, and Dehra Dún, are given. The first group of stations is at an average distance of 20 to 30 miles from the base of the hills, and the distance of the other group is under 20 miles. In both groups the stations are arranged in order from east to west. The table might be extended indefinitely in both these directions as well as southwards, but little would be gained by doing so, since the distribution of rain above described is seen clearly enough from the figures as they stand.

The average rainfall of the line of stations at a distance exceeding twenty miles from the Himálaya is 40·1 inches, and that of the stations at a distance less than twenty miles is 46·6 inches. In each group the total rainfall gradually diminishes in passing from the extreme east of Rohilkhand to the neighbourhood of the Ganges, where it increases suddenly and again gradually shades off to the westward. The mean wind directions for the rainy season at Roorkee, Meerut, and Delhi indicate that there is frequently a sort of eddy formed at that season near the upper course of the Ganges, probably by the meeting of the south-east winds of the plain with south-west winds from the Arabian Sea that have been deflected northward by the Aravali hills in Rájputána, and this may be the cause of the increased rainfall that is observed.

On the mountains the rainfall varies rapidly with height, and its quantity is to a very great extent dependent on the situation of the place to the windward or leeward of high ridges and peaks. At fairly exposed stations of nearly equal altitudes there is a gradual diminution of the annual rainfall on passing from west to east, and between the Ganges and Jumna there is a slight increase perfectly comparable to that which occurs on the plain in the districts of Bijnor and Saháranpur. Thus the annual rainfall of Darjiling is 120 inches, that of Naini Tal 91 inches, that of Mussooree 95 inches, and that of Chakráta, Simla, and Marri 62, 68, and 58 inches respectively.

The next table gives the average monthly and annual rainfall of twenty places on the Himálayan slope, classified into three groups according to their positions near the foot of the slope, on the outer high ranges or on the inner ranges and valleys.

XVI.—*Rainfall of stations on the plains near the base of the Himálaya.*

Station.	Elevation in feet.	January.	February	March.	April.	May.	June.	July.	August.	September.	October.	November	December.	Year.	Number of years
		″	″	″	″	″	″	″	″	″	″	″	″	″	
Nawábganj	640	1·28	1·15	0·55	0·27	1·29	5·82	16·94	11 79	8·02	1·51	...	0 49	49·11	16-17
Baheri	690	1·12	1·40	0·63	0 28	1·25	5 35	17·62	11 59	6 55	1·16	0·02	0 43	47·40	16-17
Thákurdwára	720	1·55	1·63	0·73	0 56	1·06	5·95	14·02	11·71	5·91	0·79	...	0 63	44 54	16-17
Bijnor	800	1·14	1·22	0·86	0·54	0 70	4·81	10 47	9·32	5·41	0·53	0 05	0·40	35·45	31-33
Deoband	870	1·31	1·60	1·20	0·31	0·88	2·86	10·31	8·16	3·49	0·28	0 03	0·61	31 04	16-17
Sahárnpur	950	1·42	1·51	1·09	0·42	0·82	4·46	12·32	9·77	3·68	0·50	0·16	0·61	36·76	31-33
Ambála	820	1·41	1 38	1 01	0·63	1·03	4·18	11 53	8 75	4·37	0·84	0·14	0·71	36 18	25-26
Puranpur	620	1 32	1 90	0·53	0·50	0.62	5 39	20·28	15 00	8·80	2 25	..	0 82	57 41	6-7
Pilibhit	630	0·99	1·41	0 45	0·37	1·15	6·25	16 17	12·06	9·72	1·31	..	0·48	50·36	16-17
Rudarpur	720	1·18	1·42	0·80	0·32	1·16	5·74	15 11	11 30	5·39	1 02	...	0 47	43 91	20-21
Káshipur	750	1·48	1·53	0·79	0 49	1·43	6·05	13 53	11·70	5·29	0·83	...	0·69	43·81	16-17
Dhámpur	780	0·96	1·84	0·74	0·58	0·95	4·22	13·12	11·87	5·29	0 50	...	0·63	40 70	16-17
Nagina	850	1·18	1·79	0·81	0·54	0·95	5·03	14·24	13·02	6 24	0·54	...	0·72	45 06	16-17
Najibabad	870	1·49	1·92	0·92	0·78	1·02	5·64	15·50	14·11	7·23	0·88	.	0 71	50·20	16-17
Roorkee	890	1·95	1·63	0·95	0·36	1·04	4·83	12·62	12 05	4·75	0 72	0·19	0·42	41 51	26-27

XVII.—*Rainfall on the Himálayan slope.*

	Station.	Elevation (in feet)	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.	Number of years.
			″	″	″	″	″	″	″	″	″	″	″	″	″	
BHÁBAR, SIWÁLIKS, AND DEHRA DÚN	Kilpuri ...	800	1·32	1·72	0·84	0·56	1·35	8·08	19·86	15·63	8·79	1·40	0·01	0·50	60·12	16-17
	Haldwáni ...	1,430	1·10	3·18	1·78	0·79	1·32	10·61	21·74	20·67	10·51	1·45		0·61	74·06	16-17
	Hardwár ...	1,100	2·98	2·80	1·04	0·08	0·45	4·38	10·33	16·59	5·56	1·03	0·06	0·39	45·69	5-6
	Mohan ...	1,330	3·65	2·91	1·82	0·83	0·79	9·23	19·86	17·48	5·70	1·72	0·58	0·50	65·07	4
	Bhogpur ...	2,450	1·47	3·27	1·23	1·27	1·87	8·63	57·83	58·30	19·92	0·80		0·10	157·69	2-3
	Dehra ...	2,230	2·06	2·10	1·41	0·73	1·89	8·32	24·61	23·66	9·14	0·75	0·07	0·62	74·86	31-33
	Ambári ...	1,800	1·67	2·38	0·85	1·13	2·67	11·65	24·58	23·73	8·20	0·42	...	0·57	77·83	2-3
	Kálsi ...	2,000'	2·21	3·42	2·22	0·96	1·54	8·02	25·09	26·91	10·04	0·89	0·04	0·99	82·33	16-17
OUTER RANGES.	Naini Tál ...	6,600	3·04	3·24	2·34	1·78	2·97	15·42	24·60	23·77	10·24	1·80	0·15	1·59	90·94	30-31
	Mussooree (St. Fidelis's. School).	5,850	2·48	3·67	1·47	3·27	4·28	13·99	37·16	54·30	19·20	0·20	...	2·23[1]	142·25	1-3
	Mussooree (Hospital) ...	6,550	2·00	3·29	2·98	1·90	2·71	9·90	29·35	31·27	9·64	1·09	0·09	1·01	95·23	16-28
	Chakráta ...	7,052	1·41	3·05	3·41	1·88	3·13	7·97	17·23	16·31	5·94	0·61	0·13	1·16	62·23	11-12
	Landaur ...	7,511	2·47	1·44	1·68	2·49	4·60	7·24	26·41	30·86	7·69	0·62	0·68	0·95	87·13	5
INNER RANGES AND VALLEYS	Champáwat ...	5,550	2·12	3·59	2·23	1·49	3·54	7·46	14·93	11·36	6·72	2·14	...	0·97	56·55	16-17
	Pithorágarh ...	5,500	1·72	2·83	1·84	1·72	3·28	7·68	13·14	9·92	4·59	1·38		0·82	48·92	16-17
	Almora ...	5,490	1·88	2·08	1·54	1·09	2·16	5·90	9·84	8·11	4·57	0·93	0·19	0·65	38·94	35-37
	Ránikhet ...	6,069	1·64	2·61	1·60	1·62	3·11	5·81	13·69	11·11	5·05	0·78	0·08	1·18	48·28	9-10
	Pauri ...	5,350	2·61	2·98	2·29	1·29	2·63	5·42	13·71	12·65	5·03	0·64	0·20	0·77	50·22	30-31
	Srinagar ...	1,750	2·20	3·44	2·38	1·05	2·25	4·35	8·80	8·05	2·71	0·66	0·02	0·72	36·63	16-17
	Leh ...	11,538	0·10	0·01	0·01	...	0·05	0·03	5·20	0·71	0·21	...	...	..	1·32	3

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[1] Interpolated from upper station in some years.

The influence of an elevated ridge in diminishing the rainfall of the valley behind it is seen on comparing the rainfall of Almora with that of Naini Tál, or even by comparing Srinagar with Pauri, though both of these lie far in the interior of the mountain system. A much greater contrast is observable between Bhogpur, at the foot of the mountains overhanging the gorge of the Ganges above Hardwár, and Dehra, in the Dún, behind the central and highest part of the Siwálik chain. The rainfall of Bhogpur, given by the observations of two and a half years is, however, probably too high.

The variation of rainfall with height can only be roughly determined, because every high ridge and peak thus cuts off the supply of vapour from the lower ground to the north of it. In Table XVIII. an attempt has been made to determine it approximately from the rainfall figures in the first two sections of Table XVII., together with those of two or three places in the hills north of the Panjáb and the observations made by General Strachey at Níti in 1849. The ratio between the mean rainfall of each hill station and that of the nearest station or stations on the plains, for the same years, is given in the last column.

XVIII.—Rainfall of the outer slope of the Himálaya compared to that of the neighbouring plain.

HILLS.			PLAINS.			Difference of elevation.	Rainfall ratio.
Station.	Height in feet.	Rainfall	Nearest station or stations	Height in feet.	Rainfall.		
		"			"		"
Kilpuri .	800	60·1	Rudarpur ...	720	43·9	80	1·37
Hardwár ...	1,100	45·7	Roorkee ...	890	40·2	210	1·14
Pathánkot ...	1,160	50·2	Gurdáspur ..	900	30·1	260	1·67
Mohan .	1,330	65·1	Roorkee .	890	39·8	440	1·64
Haldwáni .	1,430	74·1	Rudarpur ...	720	43·9	710	1·69
Ambári .	1,800	77·8	Saháranpur and Ambála,	890	30·0	910	2·59
Kálsi ..	2,000	82·4	Ditto ...	890	34·0	1,110	2·42
Núrpur ..	2,050	79·3	Gurdaspur . .	900	30·1	1,150	2·60
Dehra ...	2,230	71·9	Roorkee ...	890	41·5	1,340	1·80
Bhogpur ..	2,450	157·7	Ditto .	890	30·0	1,560	5·26
Pálampur . .	4,000	118·0	Gurdáspur ...	900	28·7	3,100	4·11
Dharmsála ..	4,490	123·2	Ditto ...	900	33·1	3,590	3·72
Mussooree (1)	5,850	142·2	Roorkee .	890	32·0	4,960	4·44
Mussooree (2)	6,550	95·2	Ditto	890	41·5	5,660	2·29
Naini Tál ...	6,600	90·9	Rudarpur .	720	43·9	5,880	2·07
Simla ...	6,950	68·6	Ambála	[illegible]	[illegible]	6,130	1·90
Chakráta ..	7,050	62·2	Saháranpur and Ambála,	890	[illegible]	6,360	1·71
Landaur ...	7,510	87·1	Roorkee	890	[illegible]	6,620	2·05
Níti ..	11,400	5·5[1]	Roorkee and Rudarpur,	[illegible]	[illegible]	10,660	0·12

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[1] Rainfall of July, August and September, 1849; the observations at Níti taken by General Strachey.

By grouping together the ratios for the places lying between the even thousands of feet, many of the irregularities that appear in Table XVIII. are cleared away and the results may be accepted with more confidence. The excessive rainfall of Bhogpur, for example, will to some extent counterbalance the defect at Dehra caused by the position of the latter station behind the ridge of the Siwáliks. The following figures are thus obtained :—

Height above plain.			Mean height	Rainfall ratio.	
				Observed.	Calculated.
		Feet.	Feet.		
0 to	...	1,000	435	1·68	1·83
1,000 „	...	2,000	1,290	3·04	3·01
3,000 „	...	4,000	3,350	3·91	3·77
4,000 „	...	5,000	4,710 [1]	3·48	3·15
5,000 „	...	6,000	5,770	2·18	2·39
6,000 „	...	7,000	6,370	1·89	1·89
10,000 „	...	11,000	10,660	0·12	0

The ratios in the last column are calculated by means of a formula, $R = 1 + 2{\cdot}12\,h - 0{\cdot}47\,h^2 + 0{\cdot}025\,h^3$, given in the official *Report on the Rainfall of the North-Western Provinces and Oudh*, published in 1879. It was originally computed from somewhat different data, but it represents the observed ratios in the above table as closely as can possibly be expected, considering the nature of the observations. At elevations greater than 9,585 feet above the plain this formula gives increasing values for the rainfall, and is therefore inapplicable; but from 7,000 feet above the plain upwards the rainfall ratio may be approximately represented by a logarithmic formula, $\log R = 2{\cdot}151 - 0{\cdot}287\,h$. In both formulæ h is to be expressed in thousands of feet.

The mean rainfall along Rohilkhand and the Doáb, at a distance of twenty miles from the hills, is about 43 inches, and the mean elevation of this line above sea-level is 800 feet. Applying the formulæ in the preceding paragraph to these data, we find that the average rainfall on the southern slope of exposed mountain ridges in Kumaon and Garhwál would probably be the following :—

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[1] The observations for the lower Mussooree station being for a very short period only, the figures for the stations immediately above and below it in Table XVIII. have been included in striking the average.

At	800	feet	above the sea	13	inches.
,,	1,000	,,	,,	60	,,
,,	2,000	,,	,,	125	,,
,,	3,000	,,	,,	159	,,
,,	4,000	,,	,,	164	,,
,,	5,000	,,	,,	119	,,
,,	6.000	,,	,,	122	,,
,,	7,000	,,	,,	88	,,
,,	8,000	,,	,,	52	,,
,,	9.000	,,	,,	27	,,
,,	10.000	,,	,,	14	,,
,,	11,000	,,	,,	7	,,
,,	12.000	,,	,,	4	,,

From the table it appears that the maximum rainfall occurs about 4,000 feet above the sea. The exact height of the maximum zone determined by the formula is 2,948 feet above the plain, or about 3,750 above sea-level. This agrees very closely with the mean altitude at which a rising column of air reaches its dew-point in the rainy season.

By far the most important if not the only cause of rain in the Himálaya is the cooling of the air by expansion as it ascends the mountain slope. It has been already seen that in the rainy season, the direction of the wind at all elevations in the Himálaya up to 15,000 or 16,000 feet, if not higher still, is from some southerly quarter. Near the foot of the hills the prevailing direction is south-easterly, but at most of the stations from the level of Dehra Dún upwards the wind blows from some point to the west of south ; that is, more or less nearly at right angles to the axis of the mountain zone. The air in rising to surmount the barrier has its heat rapidly converted into the work of expansion, and it commences to precipitate rain when the temperature falls to the dew-point. When once condensation begins, the rate of decrease of vapour with height will be a measure of the quantity condensed or the rainfall. This rate is greatest at the lowest elevations ; and thus rain should be heaviest at places on the outer slope of the mountains where a rising stream of airs usually begins to precipitate moisture, as the observations prove to be the fact.

The slight rainfall of places like Almora and Srinagar, to the leeward of a higher mountain mass is caused by the partial exhaustion of the vapour in crossing the mountains and by the dynamical heating of the air as it streams down towards the valley, both causes diminishing the tendency to condensation. The rapid decrease of rainfall on ascending beyond 6,000 or 7,000 feet is due simply to the exhaustion of the vapour, but at all elevations the influence of high ranges in cutting off the supply of vapour is easily seen. Regarding the rainfall of 1849 on the Tibetan table-land, General Strachey says:—"In the country beyond Níti no register was kept; but during a week of rainy weather in the middle of August 1·5 inches fell at Níti, while at Sanjar, beyond the watershed, where I was then encamped, at 16,500 feet, the rain never exceeded a very faint drizzle, and could hardly have been susceptible of measurement." At the Leh observatory all through the summer the rainfall hardly ever exceeds a few drops, and the greatest fall in a month during several years was an inch and a half. Sir Joseph Hooker's experience in Sikkim supplies us with facts quite parallel to these. In August, 1849, he says 26·8 inches fell at Darjíling, while in the interior, at the same elevation, but in the rear of the first masses of snowy mountains only 12·5 inches were measured. Between the 8th of September and the end of the month only 1·7 inches fell at Mome Samdong, about 15,500 feet above the sea, while at Darjíling 10 inches fell, and other instances of a similar nature might be cited.

The variation of rainfall with season is very distinctly marked in India. At all the stations in Tables XVI. and XVII., and at almost every station on the North Indian plain, the driest month of the year is November. In the great majority of years no precipitation whatever occurs in this month or in the first half of December, except perhaps on the higher mountains towards the north-west where the winter snows usually begin before the end of November. About Christmas a few showers of snow usually fall on the outer hills, and at the same time there is a slight precipitation of rain over the plains of the Panjáb and the North-Western Provinces. These winter snows and rains increase in quantity and in frequency on the hills and in the north-west Panjáb until February or March, but on the plains of the North-Western Provinces and Behar the maximum occurs in January.

The cause of the winter rains and snows has already been pointed out in describing the annual changes of the winds. In October and about the beginning of November the air over Northern India is as near as it ever attains to a condition of statical equilibrium. It is subject to the diurnal oscillations called the barometric tides and to the accompanying mountain winds, but there is little permanent movement of the air in any direction. During the cold weather, however, the neutral plane of pressure gradually sinks and the south-west upper currents of the atmosphere are then forced to ascend the slope of the mountains where they precipitate more or less of the vapour they contain. On the lower hills the temperature increases so rapidly in March and April that the tendency to precipitation, and consequently the rainfall, becomes less than in January and February, though the upper currents continue to blow from nearly the same direction as in winter. Along the southern declivity of the great snowy range, however, thunderstorms are of daily occurrence at this time of the year, and above the snow line considerable quantities of snow are frequently precipitated. In Ladák the heaviest falls of snow observed by Captain H. Strachey in 1848-49 occurred in April; but during the three years, 1876-78, there was no precipitation at Leh in that month.

April and May are the months in which hail is most frequently noticed in the Himálaya. No regular registers of this phenomenon have been kept, but nearly every year several hailstorms occur in the outer hills, and the stones are often of large size. On the 11th of May, 1855, a hailstorm occurred at Naini Tal in which many stones of 6, 8, 10 and even 24 ounces were observed to fall, the circumference of these varying from 9 to 13 inches. In 1878 there was a storm in which large hailstones fell, some of them so heavy that they punched holes through the zinc roofs of the houses, while the quantity was so great that it lay in shady places, where covered with leaves, for nearly a month.

About the middle of June usually, and sometimes before the end of May near the foot of the hills, the hot north-west winds of the plains give way to sea winds from the Bay of Bengal. The whole of the lower atmosphere over India is then moving towards the Himálaya; and the upward deflection of the air currents by the mountains causes frequent precipitations of rain in the manner already described. The rainy season almost always commences sooner on the mountains than on the plains, for saturation is reached first at high elevations and then propagated downwards by the cooling effect of the falling rain drops and the cutting off of the sun's heat by clouds. At most places in India, and in the inner parts of the Himálaya, July is the rainiest month, but on the outer slope of the mountains August is equally or sometimes even more rainy, especially towards the north-west of the chain.

While the rainy season lasts, the parts of Ladák about Leh, and the Tibetan plateau generally, receive perhaps, on the whole, less precipitation than in winter, because the temperature is then so much higher than on theIndian side of the chain, this high temperature greatly decreasing the relative humidity of any air that may reach the plateau from the south. It is probable also that the high snowy peaks, lying above the limit of the monsoon current proper, receive less precipitation in summer than in winter. At the turn of the seasons, however, about the end of September, falls of snow amounting to several feet in thickness sometimes occur on the passes over the Indian watershed.

Shortly after the autumnal equinox, about the end of September or beginning of October, the rains cease all over Northern India. The sudden cessation of the rainy season seems to be in some measure determined by the rapid diminution of solar heat, as the sun retreats to the south of the equator. It is possibly to this that we must attribute the somewhat remarkable regularity of the recurrence of two or three days' incessant rain frequently experienced in Kumaon about the 20th of September. On the plains, also, it is well known to the natives of the country that if rain falls in the *nakshatra* (lunar mansion) of *Hathiya*—that is, in the last week of September or first week of October, it is likely to be heavy. Excessively heavy rain, like that of the 17th and 18th September, 1880, when 30 inches fell in little more than two days at Naini Tál and produced a disastrous landslip, cannot, however be thus produced by a simple loss of heat, but requires a powerful indraught of moist air to keep up the supply of vapour. The heavy rain observed on the plains at "the break-up of the monsoon," and probably also that which falls at the same time on the outer hills of Kumaon, must be due chiefly to the minor storms of a cyclonic character that are frequently formed near the head of the Bay of Bengal at the turn of the season, and pass inland in a north-westerly direction.

CHAPTER VI.

Economic Mineralogy.

CONTENTS.

Mining history. Experiments in Garhwál. The Kumaon Iron Works Company. Causes of present poor returns. Mode of mining: excavation: removing the ore: crushing the ore: cleaning the ore: drainage. Smelting operations: refining the ore. Division of profits. Improvement needed in appliances. Chili furnace: English system. Outturn. Financial results of the settlement of the revenue derived from minerals. Gold: Tibetan gold-fields: Thok Jalung mines. Silver. Copper mines. Rái mine and its ores. Síra mines: Gaul and Sor Gurang. Bournonite. Copper mines of Garhwál: Dhanpur: Dhobri: Pokhri: Chaumattiya mines: Rája's mine: Nota mine: Thála mine: Danda mine: Tálapungla mine: Kharna mine: Agar Sera mine. Iron mines: Kumaon iron mines. Giwár mines. Garhwál mines: Nágpur: Dasauli: Iriyakot. Lead. Arsenic. Lignite. Graphite. Sulphur. Borax. Gypsum. Soap-stone. Asbestos. Silajít. Limestone. Building stone. Roofing slate. Alum.

Mining history.

THE mineral resources of the Kumaon division early obtained the attention which their traditional value assumed to be due to them, and it was one of the directions to the first Commissioner to procure specimens of the ores to be found in Kumaon and transmit them to the mint for assay. Specimens of copper ore from the mines in Síra and Gangoli were accordingly forwarded to Calcutta in 1815, but the report was not favourable; for, if the specimens sent were fair samples of the ores in general, it was doubted whether the mines could be worked to advantage.[1] The Government were, however, not satisfied with this report, and in 1817 deputed Mr. A. Laidlaw as mineralogical surveyor to accompany Lieutenant Webb's party through Kumaon. His orders[2] were to consider the examination of the mineral resources of the country his primary duty, though at the same time he should not feel himself debarred from bestowing attention on any other matters deserving of scientific research, so far as such investigation did not interfere with his more immediate duties. These instructions further go on to say:—"You should ascertain the existence or otherwise of mineral productions applicable to purposes of public use, or available as a source of revenue; and report on the practicability of bringing them to account. The existence of iron and copper ores in considerable quantity has already been ascertained; but as the working of these metals might injuriously affect important articles of British import, it is not designed that your attention should be occupied in detailing any practical arrangements for that purpose; you will not, however, consider yourself debarred from prosecuting enquiries into any circumstances regarding them which may be of sufficient interest to science to merit particular notice. In every part, indeed, of your researches it is the wish of Government that, in the first instance at least, you should contemplate rather the general capabilities of the country which you are to visit than the special means necessary for bringing them into action in any particular district; though, of course, the facility or difficulty with which metallic ores or other useful minerals could be raised and brought to market must be a leading point in your observations on them. The minuter details of machinery, mode of working, &c., are what it is meant to postpone, as these will be the subject of future determination, when the whole result of your survey shall be before Government."

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[1] To Government, dated 26th June, 1815: from Government, dated 13th January, 1816. For further information on the mineral resources of Kumaon see Moorcroft's Travels, I, 7; As. Res., XVIII, 236, Rec. Geol. Sur., 1871, 19; II, 86; (Lawder) III, 43; J. A. S., Ben., VI, 653, Glean. in Sc., I., 230.

Graphite, Glean. in Sc., III, 280; J. A. S., Ben., XXIV, 203; N.-W. P. Rec., III., N. S., 371; G. India Rec., XVII., 58.

Iron ores and works, N.-W. P. Rec., XVIII., 1, Rec. G. India, Sup., VIII, 37: XVII., 1: XXVI.: Bhábar iron works, Agra, 1856.

Copper ores and works, J. A. S., Ben., VII., 931 (Drummond): VIII., 471 (Glasfurd); XII., 453, 769 (Lushington): XIV., 471 (Reckendorf); As. Res., XVIII, 239; N.-W. P. Rec., III, N. S., 22; Glean. in Sc., I, 228.

Lignite, As. Res., XVI, 387, 397.

[2] From Government, dated 11th July, 1817. Mr. Laidlaw died at Pithoragarh in 1836, and I have not been able to procure any of his original reports

In 1826 Captain J. D. Herbert submitted his report on the mineralogical survey of the province.[1] This was followed by a report[2] in 1838 by Captain H. Drummond, of the 3rd Light Cavalry, on the copper mines at Rái in Gangoli and at Síra in Bárabísi. Captain Drummond had brought with him from England an experienced Cornish miner, Mr. Wilkin, to examine the mines already worked, and proposed that, with a view of ascertaining their actual value, a certain sum should be advanced by "Government for an experimental opening of such mines as might appear best suited to the object in view." This proposal was accepted[3] by Government, and a sum of Rs. 2,415 (subsequently increased by Rs. 1,000) was allotted to carry out the designs furnished by Captain Drummond. A report[1] on the experiments then undertaken was rendered by Mr. G. T. Lushington, Commissioner of Kumaon, in 1842.

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[1] To Commissioner, dated 10th January, 1826.
[2] J. A. S., Ben., VII., 931; and Stat. Kum., p. 358.
[3] To Commissioner, dated 26th November, 1838.

Experiments in Garhwál.

The place selected for the important purpose of determining the advantages or otherwise of working the mines under European superintendence was the Pokhri copper mine in pargana Nágpur in Garhwál. The works were carried on from 1838 to 1841 with a net loss to Government of Rs. 7,384. The Commissioner considered this complete failure to be due to the poorness and scarcity of the ores found, and not in the least to any want of skill or industry on the part of Mr. Wilkin, or any injudicious selection of the places for experiment. Mr. Reckendorf, a mining engineer, visited these mines again in 1845, and in commenting on the deductions to be drawn from Mr. Wilkin's experiment, gave it as his opinion that the operations then undertaken should not be considered as conclusive against the value of the mines.[2] The experiment should have been confined to driving a shaft some thirty or forty fathoms below the old mines, and not to collecting ores which might have been a good addition in smelting other ores, but the smelting of which alone could never be profitable.

Again, there were no proper appliances for smelting, the loss from which by the native method adopted was very great, and the ores used, from their nearness to the surface, had already lost much of their value by the slow metamorphosis of pyrites into sulphate of copper. On the whole, Mr. Reckendorf's opinion was favourable to more extended and expensive operations in the hands of a private company. Nothing of importance, however, resulted from this the first attempt to obtain some accurate information regarding the mineral resources of the Himálaya. Captain Drummond also combated[3] the conclusions arrived at by Mr. Lushington as to the mines not affording a fair field for investment of capital, and in support of his views quoted the testimony of Captain Glasfurd (Executive Engineer), Captain J. D. Herbert (Superintendent of the Mineralogical Survey), and the experts Wilkin and Reckendorf, who had actually visited and partially worked the mines. He urged that the sums hitherto expended were barely sufficient to pay for the expenses of discovering and laying open the lode, and were utterly insufficient to carry on the experiment in the only way in which it could be made to pay. Nothing was undertaken until 1852, when the mines were again opened on the same footing, but the result was failure as complete as before. No attempt has since been made towards placing the copper mines of Garhwál under European superintendence. In 1872, however, a European leased the mines and continued the extraction of the ore according to the native method, but was obliged to abandon the process, as he found the cost of the metal when manufactured more nearly approached the current rate for silver than that obtainable in the market for the best foreign copper. The copper mines in Kumaon have never been worked under European superintendence, and any remarks that I have to make on their value or fiscal history will be found under the notice of the mines themselves.

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[1] J. A. S., Ben., XII, 451, and Stat. Kum., p. 367.

[2] J. A. S., Ben., XIV., 471; and Stat. Kum., p. 335.

[3] In a pamphlet published in London in 1845, and Stat. Kum., p. 393.

Kumaon Iron Works Company.

Connected with the history of mining enterprise in Kumaon special prominence must be given to the Kumaon Iron Works Company still in existence, and whose origin is no doubt due to the continued belief, in spite of successive failures, in the possibility of turning the utilisation of the mineral resources of the province into a profitable investment. These had again in the regular cycle of inquiries become the subject of much speculation. From a review of the information before Government and the results of certain experiments made in 1856 the Directors of the East India Company sent out a Mr. Sowerby and a large staff of mining assistants in 1857 to carry on the smelting of iron on account of Government in the interior.[1] The fact was soon established that iron of an excellent quality could be manufactured at rates below the cost of iron imported from England, and a number of private individuals under the style of Davies and Co. were permitted to undertake operations for the same purpose in other parts of the lower hills.

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[1] Report on the Government iron works in Kumaon, with plans, specifications, and estimates for establishing iron works in Kumaon, and remarks on the iron deposits of the Himalayas by W Sowerby, C.E., printed as No. XXVI. of the Sel. Rec. Government of India (Public Works Department), Calcutta, 1859 These papers give a review of the English, Ulverstone, Continental, Belgian and French, Rhineland, Black Forest, Bohemian and Styrian Iron Works, and estimates and plans for adapting the approved processes of those iron countries to the Kumaon mines.

The avowed object of the Government enterprise was to induce private companies to work by demonstrating the financial and physical possibility of carrying on iron works as a remunerative industry in this province. Messrs. Davies proposed to take over the tract between the Dhabka and the Bhakra, and their proposals were accepted, with an assurance that they might proceed in confidence to make their arrangements, as Government would grant the lease sought. They therefore took over the Khúrpa Tál works in the rains of 1858, and paid their cost price in 1863. This company also erected buildings at Káládhúngi at a cost of Rs. 1,25,000. On the failure of the Government works at Dehchauri Colonel Drummond offered to take them over at a valuation. These works were given over to Drummond and Co., who paid the capital under agreement into the treasury in 1861. The forest rules were relaxed in favour of both companies, so as to allow them entire control over the fuel supplies, and eventually in November, 1862, both companies were amalgamated under the title of the North of India Kumaon Iron Works Company (Limited). Soon after the formation of the company instructions were received from the Secretary of State to construct a tramway to Khurja on the East Indian Railway, chiefly, it would appear, to afford an outlet for the iron manufactures of Kumaon. The tramway was to be laid with cast-iron rails manufactured at Dehchauri, and the company lost no time in making several thousand maunds of pig iron. Before the rails were made, however, the Government announced its determination not to undertake this line itself, but to hand its construction over to the Oudh and Rohilkhand Railway. It was essential to the success of the enterprize that some such outlet should exist, and the company accordingly determined to close its works for a time and await the opening of the line.

A license was granted by Government, but, unfortunately for the company, not executed till it was too late, and the deed of agreement contained briefly the following clauses :—1.—That a capital of 8½ lakhs of rupees should be paid before execution of the deed. 2.—That the company should pay Rs. 83,585 as the liquidated value of the works at Dehchauri, Ramgarh, and Khúrpa Tál, made over to them by Government, in four instalments, on or before the 1st September, 1862, 1863, 1864, and 1865, respectively; and in default of one payment the whole to become immediately due. 3.—To pay yearly, for the first three years from 6th June, 1861, a rent of Rs. 1,500, and thereafter a yearly rent of Rs. 2,500 and a royalty of one rupee per ton of cast or wrought iron produced, and eight annas per ton of iron ore raised and sold without being smelted; the said royalties not to be paid unless they exceed, and only so far as they exceed, the rents of Rs. 1,500 and Rs. 2,500 before named; payments to be made on the 1st May yearly. 4.—To erect during the third, fourth, and fifth years suitable furnaces with requisite appliances for the smelting or blasting of iron (no number mentioned), and during these third, fourth, and fifth years to manufacture at least 750 tons of iron per annum on an average, and thereafter till the end of the term of 50 years manufacture 2,500 tons of iron per annum on an average of three years, to be struck in May each year. 5.—That the area of the forest at the close of every ten years should be covered with at least nine-tenths of such timber like trees as stood upon it at the commencement of the term, and when less than nine-tenths the company should plant to the necessary extent, failing which they should pay for each default Rs. 20,000. 6.—Not to transfer their lease without the consent of Government. 7.—To keep all roads (not being public ways made by Government) used by them in repair, also their works. 8.—At the close of their term remove their buildings, &c., first giving Government the option of purchasing them at a fair valuation. 9.—On the failure to pay or manufacture as stipulated, Government to enter upon and possess the works. 10.—But if such failure is not due to the neglect of the company, they shall be free from such penalty.

The purchase-money of the Khúrpa Tál works was alone paid up, but the forfeiture clause was suspended by the local Government in 1868. The forest tract was never given over to the company in the meaning of the agreement, but its revenue has been separately collected and credited by Government. The license was not sent up from Calcutta till June, 1864, by which time the company had begun to see that the speculation would not turn out a profitable one. In fact the license deed was not prepared for signature until after the company had suspended operations, and then it was ruled by the Solicitor to Government that it ought not to be signed. The map of the tract to be given over to the company was not completed till 1869. So much for the relations of the company to Government, and the delay in dealing with its affairs which has been shown throughout. In June, 1861, permission was obtained for the company's manager to draw against their capital. This was expended with little result, and in 1864, as above mentioned, the company was wound up. This result was in a great measure, no doubt, due to the company being unable to raise capital in the market, owing to the defect, or rather the want, of title, which appears to be ascribable to no fault of their own. Since 1865 correspondence has been carried on in reference to the affairs of the company and plans have been proposed for its resuscitation. In 1872 the works were visited by Mr. Jones of the Roorkee Workshops and valued; he made them then worth Rs. 1,26,733, with a debt to Government of about Rs. 80,000. There can be no doubt that the works can hardly be said to have had a fair trial, and the valuable opinion of the Commissioner of Kumaon may be quoted to the effect that there is every reason to believe that, if carefully supervised and fed with capital, the works should at least turn out as favourable under any circumstances as the East Indian Railway. There is no doubt that, in the distance, the fuel difficulty exists, but at Dehchauri and Káládhúngi for many years this can scarcely be felt, and under penalties to replant, the company may fairly be allowed to have an unlimited supply from the neighbouring forest. At Ramgarh it is doubtful whether iron manufacture will pay, as the ore, though of the finest quality, lies at a considerable distance from any forests of any considerable magnitude, so that until it has been definitively settled whether coal does or does not exist in Kumaon the eventual absolute success of these Kumaon mines must remain problematical.[1] The increase of railways in Northern India and the development of the resources of this province must sooner or later press these difficulties into notice, and they will then obtain a final solution. "Too much has been written and too little done" hitherto in this direction.

Causes of present poor returns.

In reviewing the causes of the poor returns from the different mines, one that presses itself into notice on the most cursory inquiry is the comparative inaccessibility of the principal mines. [The copper mines of Síra and Gangoli, equally with Pokhri and Dhanpur, are situated on high cliffs in the interior. The talcose and calcareous formations in which the ores are found occupy the high precipitous mountains which build up the outlying spurs of the principal range, and some lie within it. This chain itself is metalliferous, as the lead mines at Ghirti between Milam and Níti, the copper indications at Tola and elsewhere in the Juhár country, and the copper and iron mines at Polar near Rudrnáth combine to show. The absence of coal and the increasing cost of wood fuel, with the distance it has to be carried when the forests near the mines have been exhausted, materially enhances the cost of production, while the difficulties of carriage in the tracts where the mines lie are often such as almost to preclude the transport of ore for smelting, and the forests in the neighbourhood of most mines only suffice for the most moderate requirements. Another difficulty is the want of labourers. The present workmen only come to work in the mines from the latter end of October to the beginning of April, and many of the less productive mines have been abandoned owing to the miner class turning to agriculture and to supplying the labour market at Ránikhet and Naini Tál. This want, however, could be supplied from Nepál were regular wages and constant employment once established. Sea-borne copper, though inferior to native copper, is from its cheapness preferred, and until capital is invested in opening up the larger mines and conducting the whole operations on a sufficiently large scale to warrant the permanent investment of capital in machinery and proper furnaces, and other appliances for the more economical working of the ore, mining enterprise must remain as it is—a practical failure in this province. It may be said that these extended experiments have already been tried in the case of the Kumaon iron works, but this remark will scarcely apply, as that is another of those unsatisfactory operations which stopped just at the point where further progress would have decided the question for or against the possibility of making mining speculation a remunerative one in Kumaon. I shall now briefly describe the mode of working and the financial results of the settlements of the revenue from mines from the official reports and papers before describing each mine.

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[1] For the materials for this note I am indebted to the office of the Commissioner of Kumaon and a note drawn up by Sir Henry Ramsay, than whom the Company and Kumaon has no more warm well-wisher.

Mode of mining.

The mode of working the mines is the same in Garhwál and Kumaon, and the suggestions for its improvement will serve for all classes of minerals. A gallery or passage is cut in the face of the hill with such slight declivity outwards as is sufficient to carry off the water. These adits have more of the nature of burrows than that of the shafts known in European mining. The section is always small, and in those parts where the hardness of the rock occasions any difficulty in working the passage is scarcely sufficient to admit of a person in a creeping posture. In no place will it allow of an erect position. Where necessary, frames of timber formed of unsawn branches of trees, rudely and even carelessly constructed, are set up to support the roof and sides. Accidents are therefore not uncommon, and the frequently falling in of the mines is one result of these imperfect protections.[1]

Mode of excavation.

The ore as well as the rock is excavated by a very different kind of pickaxe, the handle being made of a piece of wood with a knob at one end, into which a piece of hard iron is thrust and sharpened at the point. This with a miserable iron hammer, wedge, and crowbar, constitutes all the apparatus that the native miner has to depend upon. It is plain that with such tools no hard rocks can be penetrated nor can the softer ones be worked with much facility, and to this fact may be attributed the universal smallness of the passages throughout the mines, as the native miner can have his passage no larger than the rock which encloses the ore and its matrix will admit of. Proper pickaxes and steel gads (wedges) should therefore be substituted instead of the inefficient tools in use, and when blasting may be required the necessary materials should be provided. The miners work during the day, using torches made of dry pine, and clear out on an average from ten to twelve maunds of ore.

Removing the ore

The ore is removed from the mine by boys, who pick up the stuff with their hands and put it into skins, which they drag along the floor by means of a rope and cross handle attached to their neck to the entrance of the mine. In most mines the greater part of this work must be done in a creeping posture, the string from the skin being fastened around the waist of the dragger. In place of this method wheel-barrows or sledges on four wheels and shovels should be used when the passages are enlarged and properly supported with sawn timber.

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[1] Paras. 19, 20, Captain Herbert's report, already quoted.

Crushing the ore.

The ore or *dhán* being delivered at the mouth of the mine is reduced to a small size either by the water-mill or by the manual labour of women. A large stone is placed on the ground on which they lay the ores; they then, either with a stone or a large hammer, and more frequently the former, proceed to pulverize the ore and pick out the impurities. In this way a woman may manage one to two maunds (82lb avd.) a day, according to the hardness of the ores. In Cornwall a woman will pulverize from 10 to 15 cwt. per day, according, as in the former case, to the nature of the ores. The method in practice there is, first, to dispense with the picking; secondly, to have the ores elevated, so as to enable the individual to stand while working, and to have a plate of iron about a foot square and two inches thick on which the ores are broken with a broad flat hammer. The impurities are then finally separated by a peculiar mode of dressing the ores with a sieve, by which a boy gets through with from one and a half to two tons per day. The ores are conveyed to the women, and from them to the boys by a man who attends for that purpose.

Cleaning the ore.

The washing of the ore in Kumaon also is performed by women, who carry the stuff in baskets from the entrance of the mine to a stream, where they contrive by dabbling it with their hands to wash off the mud and finer particles of the earth. They then proceed to pick out all the pieces of ore they can get hold of; or, in the case of what may be submitted to the water in a commuted state, they work this against the stream, so as to gather it clean at the head of a small pit by handfuls; but, from the bad construction of the pits, it is with difficulty that this is performed. After picking up any larger pieces of ore which may have gone back with the stream, they scoop out the refuse with their hands, and then proceed with another charge. In Cornwall, one woman provided with a wheel-barrow and shovel for the conveying and washing of the ores, and a boy with a sieve for dressing them, as formerly mentioned, would accomplish a task equal to that of ten women on the system described.

Drainage.

The drainage of the mine is managed in a proper manner by an adit. But whenever any attempt is made to go below it, as is the case in most if not all of the mines, the water is then raised in wooden buckets, handed from one man to another until they reach the adit into which they are emptied. In this manner six, ten, or even more men may be employed, whilst only an inferior number can be spared for excavating the ores. At the Sira mine, for instance, six men were found constantly engaged in lifting up the water, and there were only two at the ores: the work done by these six men could be effected with a hand-pump by one man; but in order to keep the pump constantly going, two men might be required, and the remaining four added to the number of those who are excavating.

Smelting the ore.

The furnace of the *Dhanauriya* or smelter is very simple, and is made of common stone and clay faced with slabs of quartzose schist, luted with a compost of chaff and clay. It is about 3¼′ long by 2¼′ broad, with an ash-pit about six inches square, all of which are built inside a house about 12′ by 14′, of which the roof is composed of planks. (Figs. A, B.) The operation of smelting takes about 28½ hours, during

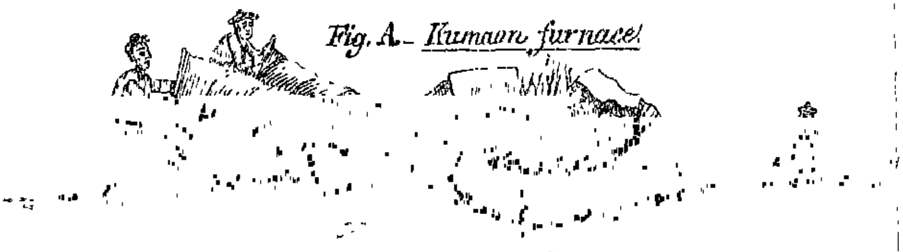

Fig. A.— Kumaon furnace.

Fig. B.— Vertical Section, from the front.

which time the fire is kept up, and after that the facing slabs and luting require renewal. The implements used are a crowbar, poker, shovel, and a pair of buffalo hides, dressed whole, to form the bellows, the neck of which forms the nozzle, and the buttock the valve for the ingress of air. The hides for making them are worth Rs. 12 apiece.[1] The furnace being freshly luted, the ash-pit is filled with charcoal dust and chaff, and a fire being lit, six baskets of iron ore, each containing about thirty sers (the ser = 2lb. 2oz. avd.), are placed round the fire. The blast is then commenced, one bellows being inflated while the other is undergoing depletion. In about half an hour the slag commences to flow from the floss-hole, which is kept open by a poker. In about two hours more, the ore having subsided considerably, two more baskets of ore and a corresponding supply of charcoal is given with a new luting for the bellows nozzle. In another two hours, this having also subsided, the charge is deemed ready. The fire is then raked out through the flosshole, and the charge, consisting of a pasty mass called *phalka* or *jhanj*, is shoved out with a crowbar by the smelter. The same operation is repeated until seven blooms are obtained, consuming thirty-eight baskets of ore, thirty-one of which are converted into the seven blooms, and the remainder, comprising the partially roasted ore, become the property of the smelter. The charcoal consumed weighs 340 sers, or a little more than the seven blooms, which weigh 327 sers, or about one-third of the ore expended (930 sers). Each bloom consists of three qualities of metal, all intermixed with earthy particles. These are kept separate, and are broken into small pieces before being sent to the *khatauniya* or refiner.

Refining the ore.

The furnace of the refiner is smaller than that of the smelter, and the implements required are a pincers, poker, two or three sledge-hammers, an anvil, and bellows. The fire being lit, a mixture of one-sixth of first quality, one-sixth of second quality, and the remaining two-thirds of third quality, in all about six sers of bloom metal, is placed on the hearth opposite the bellows, with the larger pieces nearest the fire. The blast having commenced, in a quarter of an hour the slag begins to flow, and in another quarter of an hour the metal (now a porous, pasty mass) is taken out of the fire and subjected to the blows of two or more sledge-hammers; the blows being slight at first, to prevent the metal flying into pieces, but as it becomes more solid, they are given with the full force of the workmen. Meanwhile a fresh supply of bloom-metal is placed on the hearth, as at first. The hammered mass, after several hammerings, assumes the shape of a small bar, weighing one and a quarter ser; it is thick in the middle and tapering to either extremity, and six sers of charcoal have been used in its formation. This bar is now fit for the market, and is called by the workmen *phala*, but by the plains-people *pain*. The charcoal used by the refiner is made from the dry trunks of fir trees which have been felled for two or more years, while that made use of by the smelter is made from small green wood. The refiner class is subdivided into another, called Bhadeliya, who, instead of making the iron into bars, manufacture it at once into cooking utensils. Nine hundred and thirty sers of ore produce 327 sers of bloom-metal, which in its turn produce 82 sers of marketable bar-iron, or only 8·8 per cent. The bloom operation consumes 340 sers of charcoal and the refining process 667 sers, so that for every ser of iron produced 8·2 sers of charcoal are consumed. The Swedish furnace only consumes 1·33 times the weight of the iron produced.

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[1] Beckett, III., Sel. Rec., N.-W.P., 25.

Division of profits.

The mines are leased for a term of years to contractors for a certain sum, and the lessee collects for the season from the different classes of workmen at the following rates: from each *son* or miner Rs. 2½; from each gang of smelters Rs. 4½; from refiners of the Khatauniya class Rs. 4½, and from those of the Bhadeliya class Rs. 6. The miner is originally sole proprietor of the ore, which he takes to the smelter to reduce into blooms, giving him for his trouble one basket of ore (30 sers) and one basket of charcoal (5 sers) for each bloom turned out; also for each set of seven blooms 16 sers of grain, and food for one man for four days; and at the end of the season a suit of clothes. Sometimes, however, owing to the smelter being largely in debt to the miner, he does not receive any charcoal from him. The smelter can only work for certain miners, generally five in number, not being allowed to work for any other miners; or, in other words, each party of five miners employ one family of smelters exclusively.

Each party of smelters must consist of at least five persons, but they generally count eight to ten persons. The share of each party of refiners is one half of the bloom-metal made over to them to refine, no further remuneration being allowed them. Refiners, unlike the smelters, are not bound to work for any particular person, but may work for any one that chooses to patronize them.

Improvement needed in appliances.

In the roasting and smelting of the ore Captain Herbert recommends a system of reverberatory furnaces for these two different processes. An excellent material is at hand in the indurated talc known as potstone, which, though soft, is infusible. The simple blast furnace in use in Chili would also be an improvement. It is of a circular shape, similar to a lime-kiln, covered with a dome to confine and concentrate the heat. The ore is arranged in it in alternate layers with the fuel, which is wood, and being lighted it continues burning for a considerable time. When required, the heat is urged by a double pair of bellows worked by a crank turned by a water-mill.

Chili furnace.

English system.

The methods of reduction practised in England, where the subject is best understood, vary with the ore, and even with the establishment. But the differences are trifling and only affect the minor details. The two great objects to be effected are, first, by a proper calcining heat to drive off the volatile ingredients sulphur and arsenic, and to oxidate the iron, thereby promoting the fusibility of the ore and consequent separation of the metal from the scoria when in fusion; and, secondly, by an intense and properly continued fusing heat to effect the vitrification of all the impurities which thus form a slag at the top and are skimmed off while the metal sinks down in a comparatively pure state. To promote this vitrification of the ingredients occasional additions are made to the ore as the case may seem to require, though in general the run of the ores is such as to require little beyond a few slags of an old smelting. The operations of roasting and smelting are repeated several times, each smelting being followed by a roasting, to expedite which effect in the case of copper the ore is, after each smelting but the last, let into water to be granulated. This separation of the metal into such small parts assists the calcining power of the furnace, and the work is more speedily effected than if performed on the mass. After the last smelting comes the process of refining or poling, which consists in keeping the copper in a melted state covered with charcoal, and introducing from time to time a wooden pole into the melted mass to produce the evolution of gaseous matters. Lead is sometimes used both in Hungary and England to expedite the previous operations of the refinery. The oxides of this metal are amongst the most powerful vitrifiers known. As such they are effectual in the assay and refinery of the precious metals, and as such they may be also used with copper. But the process requires attention, for if not stopped in time, or if too much lead be added, the copper itself will be oxidated and vitrified.

The process of manufacturing iron from the ores is different from that of copper, inasmuch as none but the oxides or carbonated oxides of the former metal are ever employed. In the copper ores, that is in those which occur in any quantity, the metal is combined with sulphur, which can only be driven off by repeated roastings. In the iron ores the metal is united to oxygen and mixed with various earthy impurities. In reducing these ores, then, there are three distinct points to be attended to: first, the provision of a substance which shall effectually take the oxygen from the ore, leaving the metal mixed only with its earthy constituents; second, the proportioning the flux used to those earthy ingredients so as to insure a complete vitrification of them and separation from the metallic particles; and third, a sufficient heat to fuse the latter, that the separation and reduction may be more complete. The first point is attained by using a sufficient quantity of charcoal in the reduction of the ores; the second by adding, as the ore may require it, limestone or other flux; and the third point is only to be effected by using a powerful blast furnace.

Outturn.

It is not easy to give the outturn from the mines, the arrangements are so intricate and the returns so imperfect. In 1868 about 29 maunds of copper were raised from the Kumaon mines, and in 1869 the same mines yielded the same amount, of which 21 maunds were exported. The Dhanpur mines in Garhwál yielded 10 maunds of copper in 1869, but every year since the produce has decreased. In 1868 the Kumaon iron mines yielded about 2,000 maunds of metal, and the Garhwál mines about 1,752 maunds, while the returns of 1869 give

5,153 maunds for Kumaon and 529 maunds for Garhwál. Besides this an immense quantity of copper is imported into Kumaon in the shape of manufactured vessels for culinary purposes: about 2,000 maunds of iron also are imported from the plains against 155 maunds exported. No reliance can be placed upon the estimates of outturn in recent years, as the mines have been leased for a term of years, and the lessees are not inclined to have their affairs too closely examined.

Financial results of the settlement of the revenue derived from minerals.

Previous to the Gorkháli conquest of Garhwál the copper mines of Nágpur are said to have yielded Rs. 5,000 Gk. a year, or about Rs. 3,800 of our money. The entire mineral revenue of Kumaon and Garhwál, including mint dues[1] on the coinage of copper pice, had fallen in 1812 to Rs. 4,800 Gk., equivalent to Rs. 3,600 British currency.[1] This was mainly due to the neglect of the Gorkháli Government, under which the mines had fallen in and become choked with rubbish. Their suspicious policy prevented them from trusting their own officers, whilst their want of probity precluded any private person from venturing to sink the capital necessary to re-open the mines. In 1815 the Nágpur mines were leased for Rs. 10, and in the following year for Rs. 15, and with the villages attached to them seldom brought in more than Rs. 1,850 a year, whilst those in Kumaon were leased at Rs. 850 a year. Up to the year 1826 the revenue of the Kumaon mines was included in the assessment of pargana Rámgarh, and that of the Garhwál mines in pargana Dhanpur, and subsequently was accounted for in the returns of the pargana within which they are actually situated. Between the years 1815 and 1840 the revenue derived from mines averaged as follows:—

	Kumaon.	Garhwál.	Total.
	Rs.	Rs.	Rs.
Copper	801	2,086	2,887
Iron	1,905	226	2,131
	2,706	2,312	5,018

The highest mineral revenue of the province for any one year amounted to Rs. 5,417. This return was not altogether due to the smelting of ore, and included the land revenue of villages attached to the mines for the location and support of labourers. Mr. Beckett in his report[1] on the settlement of Garhwál gives the revenue of each mine from 1839-40 to 1863-64. The revenue every fifth year from each class of mine during this period was as follows:—

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[1] These mint dues were collected for a few years under British rule at the mines of Dhanpur and Gangoli, and at one-half per cent. yielded a revenue of Rs. 300 a year. To Board, dated 6th August, 1821.

Class of mine.	1839-40	1844-45.	1849-50	1854-55.	1859-60.	1863-64.	Total revenue from 1838-39 to 1863-64.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs	Rs.
Iron ..	609	727	779	430	272	134	3,764
Copper .	1,990	2,442	2,138	1,305	81	627	21,304
Lead ..	...	5	3	3	...	10	64
Total ...	2,599	3,174	2,920	1,738	353	771	25,132
Number of mines worked,	24	25	23	17	11	30	76

In 1865 there were 24 iron, 9 copper, and 2 lead mines worked in Garhwál, and 33 iron, 35 copper, and 3 lead mines had been abandoned. The lead mines have since been abandoned, and the revenue from copper and iron mines in 1878-79 was as follows:—

	Copper.			Iron.			Total.		
	Rs	a.	p.	Rs.	a.	p.	Rs.	a.	p.
1878	86	8	0	136	12	0	223	4	0
1879	89	0	0	153	8	0	242	8	0

There are no statistics of outturn for these years.

In his Kumaon settlement report Mr. Beckett gives the revenue of each mine from the year 1844-45 to the year 1872-73. The revenue every fifth year from each class of mine during this period was as follows:—

Class of mine.	1848-49.	1853-54.	1858-59.	1863-64.	1868-69.	1872-73.	Total revenue from 1848-49 to 1872-73.
	Rs.	Rs	Rs.	Rs.	Rs.	Rs.	Rs.
Copper ..	100	48	*Nil.*	120	67	30	2,831
Iron ..	2,274	1,751	1,532	870	929	1,120	46,126
Total	2,374	1,799	1,532	990	996	1,150	48,957

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[1] Allahabad, 1866.

The following quotation from the Commissioner's report in 1874 gives the opinion of those best acquainted with the subject on the future of the mining industry in Kumaon:—"Iron and copper abound, but at the present value of labour the mines are worth very little. The *sons* or miners have, as a rule, given up their old trade and taken to contracts. The great attraction to miners in former times was the cheapness of grain in the Khetsari valley, where iron was most extensively manufactured. This advantage no longer exists, for the market at Ránikhet has doubled the price of grain, and the miners would be no longer content to exchange their labour for the small profits on iron. Copper mines are in no greater favour. Formerly some villages where the miners reside were included in the mining leases of Kumaon and Garhwál. These villages have been settled with the miners, therefore they are no longer servants of the contractor. Tea gardens and other labour markets offer much better terms than a contractor, who, at the least possible expenditure, tries to make the greatest possible profit. These contractors know nothing about the science of mining, and they have no money to expend in penetrating beyond the worked-out galleries. In fact the mines have collapsed, and without considerable outlay no reasonable profit can be expected. Labour is expensive, and English copper can be bought at a cheaper rate in the Almora bazar than the local miners can produce it with profit. I expect nothing more from native petty contractors than a pittance which they can realize by the resident miners working when convenient to themselves, when they give half of the ore to the contractors and keep the other half. No doubt there is abundance of copper in Gangoli; but any mines, copper or iron, that are now worked barely produce sufficient for local consumption. Agricultural instruments are made for the people of the surrounding country, and a few copper vessels; but all the mines in the interior are in remote places, and too far removed from a good market to be of much value."

Gold.

The gold exported from Kumaon is either obtained from the streams within the province, or is brought down by the Bhotiya traders from Tibet. Although no mine of this metal has been discovered in the province, there are indications of its existence in Garhwál. The sands of the

Alaknanda, Pindar, and Sona furnish a small amount of gold-dust. The Ganges also is auriferous as far as Lachhman Jhúla, and the Rámganga for a short distance below its junction with the Sona. The washing is nowhere a profitable occupation, and scarcely gives an average of four annas a day for each workman. The gold obtained by washing the sands of rivers paid a small duty during the Gorkháli rule, and was leased with the forest duties for a short time after the British occupation, but the amount was too trifling to render its continuance expedient, and it was accordingly abolished by Mr. Traill. Undoubtedly a greater return might be had from this source by the use of mercury, as in Australia, for the purpose of separating the gold from the sand; for as this is afterwards recovered by a simple process of distillation, the expense would be very little more than it now is. Captain Herbert found gold in a matrix of granite near the Alaknanda.

Tibetan gold mines.

The gold imported from Tibet by traders is chiefly taken in exchange for grain or cloth to balance their accounts, as rupees are taken by them at the hill fairs for the same purpose. The principal gold mines in Tibet, *sár-chaka*, are ten days' journey beyond the borax fields further north and north-east in a district otherwise uninhabitable, named *Sár-bachyád*. These are farmed or managed by a *sár-pan* or gold commissioner on a triennial contract direct from Lhassa. The lessee in 1845 was also Garpan Urku-wa at Gartoh, and paid Rs. 17,000 per annum for the lease. He had 170 miners at work, for whose subsistence he used to send supplies from Pruang. It would also appear to be sometimes the custom to sublet 'claims' at a tax of a *sárjao* or *jao* of gold, about 7½ mashas, or ten rupees.[1] The gold mines are worked by pits and shafts under ground, where the gold is found in its pure native state, and undergoes no other process than washing and shifting, and after that requires little or no refining. In this state, tied up in little bags called *sár-shu* (H. *phatang*), weighing about 90 grains, it forms the heavy currency of the country. A superstitious belief holds ground that no large nugget should be removed, as it belongs to the genii of the place, but the Láma of Gnari is said to have one weighing nearly a ser.

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[1] H. Strachey, J. A. S. Ben., XVIII, (2), 5; J. D. Cunningham, *ibid*, XIII.; Herbert to Commissioner of Kumaon, 19th January, 1826.

Gold is sold at the same fairs as the borax, and is imported to the value of about Rs. 10 to 12,000 annually.

Thok Jalang mines.

The gold in the bags commonly current has usually not more than 7·73 specific gravity. Even the picked yellow grains have only a specific gravity of 11·96, showing that they are alloyed with some other metal. The grosser impurities appear to consist of iron more or less oxidised. One of Montgomery's pandits visited the gold mines of Thok Jalang in Rohtoh in 1867,[1] and describes it as a great excavation from 10 to 200 paces in width and 25 feet in depth, access to the bottom being by means of steps and slopes, the earth dug out being thrown on either side. The digging is carried on with a long-handled kind of spade or an iron hoe, the iron for which comes from Ladák. A very small stream runs through the gold field, and the bottom is consequently a quagmire during the daytime. The diggers dam up the water, leaving a sloping channel for an escape. A cloth is then spread at the bottom of this channel, and the channel is supplied by one man with the auriferous earth, and another gives water, so that the gold sinks to the bottom and is caught in the cloth at the end. Some nuggets weigh up to two pounds. The diggers come from the Tsang province round Shigatze or Digarcha. There are numbers of abandoned gold fields in different directions about Thok Jalang, and probably a whole series of them from Rohtoh to Lhassa. The Sárpan levies a tax of about half a tola (*saishu*), or two-fifths of an ounce, from each digger. There is no wood, and water can only be had from melted ice. A cold wind blows at all seasons, and, in consequence, the tents of the diggers are pitched in excavations in the ground to protect them from this wind. The dried dung of yaks, ponies, and sheep afford fuel. The Tibetans cook and eat three times a day, their food consisting chiefly of boiled meat, barley cakes, buttermilk, and tea stewed with butter: they also smoke a great deal. They always sleep with their knees close up to the head and rest on the knees and elbows, huddling all the clothing on to their backs. The price of gold at Thok Jalang was about 5½ to 6 rupees per *saishu*, or 30 rupees per ounce.

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[1] Rec., G. I., II. D., 36.

Silver.

Silver was brought down to these provinces from Tibet in former times. It was imported into that country from those surrounding it (probably China), and does not seem to be found in Tibet itself in any quantity. It was sent into Tibet in a crude state in lumps called *doja* or *thaka*, of a general value of Rs. 165 each. Importations from that source have ceased for some time, owing possibly to the great and growing influx of silver in the shape *of rupees from British territory. Formerly all borax, salt, &c.,* was bartered for grain, cloth, &c., but now, while a large amount is still disposed of in that way (probably to procure actual necessaries), still, whether it proceed from the increase of trade and the portability of coin for hoarding purposes, or from the existence of a greater demand for silver in Tibet, by far the largest amount of borax is disposed of here for British money. The Bhotiyas, too, state that our coin is largely current in Gartoh and the other large towns, and is preferred by the inhabitants there to the coinage of other countries. They ask for the *Cheharádár Rupaya*, or face-printed money.[1] The difference in the exchange now made up in Government rupees cannot be less than eighty thousand to one lakh of rupees per annum. This trade in rupees dates from about 1820, when they began to displace the Srinagari and Ladáki rupees.

Copper mines.

The mines of copper in Kumaon and Garhwál have never been of much practical value either as a source of supply for local consumption or as offering a valuable return to labour and capital. They are still, however, deserving of notice, and we shall now describe each in succession, commencing with the Gangoli mines in Kumaon.

Rái mine.

✓ The Rái mine in pargana Gangoli is the most important in Kumaon. The ore is chiefly pyrites in a matrix of indurated and sometimes slaty talcose and steatitic schists inclosed in dolomite. In some places the one, and in some places the other, forms the roof and sides of the mine. The dolomite has a large crystalline grain and great tenacity, and forms a perfectly durable work when excavated. The schists when massive may be depended on, and can be easily worked, but, as a rule, they occur of such inferior consistence, having much the appearance of re-united débris, that they require support, and often occasion much inconvenience and even danger. The ore occurs in the schists in numerous strings, having every appearance of being leaders, as they are called, to solid ore, and forming a distinct lode. The strike or direction of the strata is nearly W.-N.-W. to E.-S.-E., dipping at an angle of about 45° to the N.-N.-E. The copper ore is accompanied by iron pyrites which are occasionally found in the pentagonal dodecahedron form, but most commonly in such irregular and anomalous forms as can with difficulty be described. There are a few specimens of grey copper, but the working ore is undoubtedly pyrites. On visiting the mine in 1836, Captain Drummond found the lode about two feet wide, containing a good yellow copper ore, but with a large proportion of its matrix talcose, twenty per cent. only being metalliferous. The ore is extracted in the usual way by means of drifts slightly inclining upwards, to allow for drainage. The adit at Captain Drummond's visit was driven on the course of one of the lodes which continues west about 60 feet, when it falls in with another lode that alters its direction to 15,° and afterwards to 30° north, inclining nearly 50° to the east of north. At that time the adit had penetrated some 348 feet from the entrance. The ore had been taken away from beneath as far as the miners could excavate it, and the hollow had been filled up with rubbish. From above, too, the ore was taken away as far as it was found productive. The passage varied from two to four feet in height and from two to two and a half feet in width, being bounded by the hard dolomitic rock which the miners did not know how to remove. In 1868-69 these mines fell in and became flooded with water. About a couple of hundred yards to the north, and in the same hill, is another similar deposit of copper. This used to be laid open to the surface during the rainy season, and was then allowed to fall in, so soon as the water employed by the miners to carry off the talcose mud from the ore ceased to be plentiful. This also has ceased to be worked for some time.

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[1] Lawder in Rec. Geol. Sur.

Ore assayed.

In 1815 one specimen of fused copper from the Gangoli mine and several specimens of the ore in matrix were sent to the Mint at Calcutta for assay. The report showed that the ore was mixed with arsenic and sulphur, and produced 25 per cent. of malleable metal, but the specimens were too small to allow of any exhaustive examination of them.[1] In 1826 Captain Herbert valued the outturn at 35 per cent. of the pure ore, and in 1836 Captain Drummond gave the general result from the pyrites in their perfectly pure state as about 30 per cent. of metallic copper.[2] Pyrites, though not a rich ore, is the most important of any, from its abundance and from being generally more to be depended on for continuance than the richer varieties. In England more copper is obtained from it than from all the other ores together. The Gangoli, Síra, and Sor mines were farmed from the conquest until 1828, when they were leased for one year to the miners,[3] and were again farmed at a reduced rent in 1833. In 1815 they yielded a revenue of Rs. 850, increased to Rs. 1,201 in 1819 and 1820, and to Rs. 1,215 in 1821 and 1822, but in 1874 the whole of the copper mines of Kumaon brought in a revenue of only Rs. 30 a year.

Síra mines.

The Síra mines in Patti Bárabísi in pargana Síra are situated on the northern side of a hill somewhat higher than the one at Rái. The ore here too consists of copper pyrites, accompanied by iron pyrites in a gangue formed of dolomitic and talcose rocks. In 1816, a specimen of copper ore from the Síra mine was sent to the Mint at Calcutta for assay, with the result that it was found to contain only 24 per cent. of malleable metal, so that it was thought that this mine would not repay the working.[4] Captain Drummond found that nearly thirty-three fathoms from the entrance the adit struck on a copper lode on which a level passage was driven that continued westward, its course being about 10° south of west, and the dip northerly from 45° to 50°. The ore was harder and more mixed with iron pyrites than the ore at Rái. At the end of the level a second lode yielding a poor ore was met, and beyond it a pit was sunk which seemed to have yielded in former times fair returns.

Gaul: Sor Gurang.

The Gaul mine in Patti Kharáhi and the Sor Gurang are similarly situated, but the ore produced is in very small quantities, consisting of grey copper, copper pyrites, and carbonate of copper. Steatite and limestone are the neighbouring rocks, the steatite forming the gangue. The Sor mine had not been worked up to 1833, although a lease at a small rental had been taken out in 1821.[1] Captain Herbert notices that all these ores are free from the presence of arsenic, which, above all other metals, deteriorates the quality of the copper and is most difficult to remove.

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[1] To Government, dated 14th June, 1815. From Government, dated 13th January, 1816.

[2] See farther Stat. Kum., p. 359: J. A. S. Ben., VII., 935

[3] To Board, dated 2nd January, 1829

[4] From Government, dated 18th January, 1816.

Bournonite.

In digging the foundation of a house at Hawalbágh the workmen came on a vessel containing three crystallized specimens of bournonite, the triple sulphuret of copper, antimony, and lead, and the only trace hitherto discovered of its existence in these hills (1826). Copper pyrites also exist near Ganai and Phadiáli in Patti Athgáon in pargana Gangoli; at Bujúl and Ratháyat in Patti Bel in a matrix of steatite and feldspar; and at Támba kán in Patti Gangoli in a matrix of talcose rocks. There are small mines in Patti Gíwár, at Chín ka Káli, Beler, Sor, and at Kemakhet, on the east bank of the Ladhiya river in Káli Kumaon.

Copper mines of Garhwál.

The copper mines of British Garhwál are more extensive and have always borne a higher reputation than those of Kumaon. The principal are situated at Dhanpur and Dhobri in pargana Dewalgarh. These mines yielded a considerable outturn in former times, but of late years operations have not been so vigorously carried on, owing to the intricacy of the workings, and the idea prevailing among the miners that very little ore remains in the mines.

Dhanpur mine.

The Dhanpur mine is situated on the north side of a high and precipitous range in compact dolomite.[2] The ores are principally copper pyrites and grey or vitreous copper ores, with the red oxide and green carbonate in smaller quantities, the latter being scarce. The ores are found in a bed about fifty to sixty feet wide, which runs nearly north and south, and underlies east about one foot in the fathom. It is divided by a bed of potstone or indurated talc, which runs through the copper formation longitudinally, conforming to the strata and having a frith or flukan on the western side. The seams of ore are sometimes one foot in thickness, but seldom more than one inch. In his report on Dhanpur, in 1816, Mr. Traill declared that these mines were incapable of much improvement, and that the ore produced was not rich. The lease of the mines, including the twenty-two villages attached to supply the requisite labour and grow grain for the miners, was fixed at Rs. 1,850 a year. Up to 1829 there was little improvement, as the lessees were too poor to undertake the cleaning out of the mines, and no capitalist would venture to take them.[1] In 1838, the best seam or vein seen by Mr. Wilkin was not more than half an inch thick, and in 1841 the best lode worked was about two inches. The veins are very close together, and being softer than the matrix, the ore used to be first removed, and then the miners burned the rock with wood and threw water on it to facilitate removal. The red dolomite is of such a consistence as to seldom require props for its support, thus enabling the miners to dispense with wooden framework and to work all the year round, while the situation of the mine on the top of a hill admits of adits for drainage. The interior consists of a network of chambers from end to end.

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[1] To Board, dated 14th February, 1829.

[2] Mr. Wilkin's report, J. A. S., Ben., XII., 454; Reckendorf's report, *ibid*, XIV., 471; Captain Herbert to Commissioner, 10th January, 1826.

Dhobri mine.

The Dhobri mine is situated on the south side of the Dhanpur range in very nearly the same kind of rock as the Dhanpur mine, but in this mine most of the veins are horizontal, running along the side of the hill. At the surface they are very small, containing oxide of iron and green stains of copper, and occasionally copper pyrites. The present working mine is not extended very far from the outside of the precipice or surface, the ores being much the same near the surface as at a distance from it. When the miners find their passages growing long and tedious they begin outside on a new vein. There are several old mines west of the Dhobri village ; one of them is very extensive, and the ores seem to have been most abundant when the horizontal vein was crossed by perpendicular ores ; but the whole of the horizontal vein has been taken away. The most western of these veins is said to have been very rich, but it fell in about the time the Gorkhális entered the province, and has not been opened since. The ores of these mines are principally copper pyrites, containing 25 per cent. of copper. There is water for machinery about a mile and a half below the mine, and wood for all purposes near that place. There is another mine on this range at Maulgiri, said to be in the same rock as the Dhobri mine. There are other mines of both copper and iron in Dhanpur, but few of them are worked, and they are for the most part of little value. The mines were leased in 1872 to a European, but even then western intelligence and energy could not make them a remunerative investment. There is a copper mine in Patti Lobha at Agar Sera[1] in the face of a precipice on the right bank of the Rámganga river which was leased in 1872 for three rupees. The lessee, however, makes little profit, as the shafts have been sunk so deep that men are afraid to enter them, and the rock is too hard to allow of fresh shafts being driven, unless at great expense.

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[1] To Government, dated 14th February, 1829.

The Pokhri mines.

The Pokhri copper mines early attracted the attention of the Government of the country. For many years they had been worked by the Garhwál Rájas, and subsequently by the Gorkhális. They consist of several separate mines; that known as the Chaumattiya is situated in talc which rests on dolomitic limestone. The lode after crossing the ridge east of the mine enters a very compact basin, in which is situated the Duined mine. This has not been worked much, owing to the softness of the talc and the abundance of water, but it is said to have a good lode in one part of it. The lode then crosses the hill near Deothán, a small village above the mine, and is found near Gúgli and Keswara, where some ores have been extracted, but have never proved very profitable in working.[2]

Chaumattiya mine.

Rája's mine.

The Rája's mine is situated about 450 yards north of the Chaumattiya mine in common dolomite which rests on talcose schist. A shaft of 70 fathoms was dug by the early workers meeting an adit which must have been driven over 100 fathoms through dead ground. Several other adits were driven, and when they fell together, about one hundred years ago, there were three places where copper was found—the Gaja Chauk, Kuvera Chauk, and Bhartwál Kúa, all of which have now fallen in. The produce was about 300 sers of ore a day, yielding 25 per cent. of copper. Two-thirds were claimed by the Rája, and the remainder was left to the miners, who had also grants of land free of revenue. The experiments of Mr. Wilkin already noticed were confined to these two mines and a new mine which he opened close by. In the new mine the lode was very promising and yielded good specimens of ores near the surface, but at a depth of fifteen fathoms it became poor, and was consequently abandoned. During the time the experiment lasted the expenditure on the Chaumattiya mine amounted to Rs. 2,847, and the return in copper to Rs. 231, besides about three to four hundred rupees worth of ore. Rs. 347 were expended on the Raja's mine, and the experiment was then abandoned, and the new mine cost Rs. 246 before the operations were closed. The entire net cost of the undertaking when operations ceased was for labour, in working the mines, less sale proceeds of copper, Rs. 2,585, and for European superintendence Rs. 4,800, or a total of Rs. 7,385. These mines were then leased to a native contractor for Rs. 500 a year.

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[1] Described by Beckett in Sel. Rec., N.-W. P., III., N. S., 371. [2] For details of these mines see Mr. Wilkin's report in J. A. S. Ben., XII., 451, and Recken[illegible] in *ibid*, XIV., 471.

In addition to the three mines mentioned above there are several others in the vicinity of Pokhri, some of which were worked by the former rulers, and some again have never been opened. Mr. Wilkin noticed the principal mines, and described them as follows:—

Nota mine.

The Nota mine is situated about two and a half miles north-west of the Pokhri mines in talc, which rests on dolomitic limestone. The lode is a bed of yellow or buff-coloured talc, about four feet wide, dipping north-west at 50° ; it rests immediately on the dolomite limestone, and has a sulphuric effervescence on the surface. This mine is said to have been rich ; it is situated on the western side of an extensive basin or valley, on the eastern side of which ores have been turned up by the plough, but no mine has been worked. This is an extensive field for mining, as the lode may be productive throughout the basin or valley. There is wood and water for all purposes near this mine.

Thála mine.

The Thála mine is situated about a mile north-west of the Nota mine, probably on the same lode, in an extensive plain or comparatively level surface. It was first worked in 1810, and again in 1825, but there being no good facility for adits, the water prevented its being worked to any considerable depth. The miners who worked it state the ores to be copper pyrites disseminated in a lode of two feet wide, one-fifth of which was metalliferous. There is plenty of wood for all purposes in the neighbourhood of this mine.

Danda mine.

The Danda mine is situated on the hill, about 500 yards above the Thála mine, in chlorite slate and talc, which on the north-western side comes in contact with common dolomite. This mine has been worked to a considerable extent, and is said to have yielded Rs. 52,000 profit in one year. The ores are of good quality, and found in three or four different beds or holes which dip into the hill at an angle of 30°. The chlorite slate in which the beds of talc and ores are found is so hard as to stand without timber ; it also contains finely disseminated copper in small quantity. The lodes run into a fine fall or basin westward, in which Mr. Wilkin thought they would be found productive. There is abundance of wood near this mine, but no water for machinery nearer than the Thála mine.

Tálapúngla mine.

The Tálapungla mine is situated about a mile north-east of the Danda mine in talc, which rests on dolomitic limestone. The strata in which the ores are found is about six fathoms wide, dipping south-west at various angles. The bed is extensive, but the ores are scarce ; however, this might improve at a distance from the surface. Ores have been found in a precipice, east of this mine, near the village of Bangtál, but at present the outcrop is covered with rubbish ; it is in the talcose formation, and has good facilities for working.

Kharna mine.

The Kharna mine is situated in the ravine below Bangtál, near its junction with the Nágal river in talc ; it was discovered by the water of the ravine washing away the strata, and leaving a quantity of ores exposed to view ; these ores were taken away by the Pokhri miners and the mine was worked five or six fathoms under the surface, beyond which they were prevented from going by the water. They say that the lode at the bottom of the mine for two fathoms in length is one foot wide, of solid copper pyrites. Of late years nothing has been done at this mine beyond washing among the surface layer, which contains a small quantity of copper pyrites. There is plenty of wood in the neighbourhood of this mine and water for machinery, but no facility for adits.

Mr. Beckett has described the mode of mining and preparing the ore of the Agar Será[1] mine from which the following account has been extracted. The gangue consists of white and yellow quartz much encrusted with green carbonate of copper, and is so difficult to work that not more than 40 to 60℔. of ore can be excavated by one man in a day. The workings are dry and the lode has a dip of about 30° below the horizon with a north-westerly direction. The ore is pounded and moistened with water and receives an admixture of five parts in six of limestone as a flux. The charge, consisting of about 6℔. of unmixed ore, takes about half an hour to melt and is placed from time to time in handfuls on the furnace, and covered with oak charcoal which is occasionally moistened with water. When the fire falls in after the last supply of ore, the charge is ready to be taken out. The door of the furnace is then taken away and the remains of the fire being raked out, there appears at the bottom a melted mass which, after being stirred about a minute or two to allow the heavier particles to settle down, is sprinkled with water to harden the surface. Three or four of these charges being taken away, the melted copper is found at the bottom in a small mass weighing about $2\frac{3}{4}$ ounces, for which twelve pounds of charcoal have been used. Thus from every 100 parts of ore about $2\frac{1}{17}$ths parts of copper are procured, having consumed 200 parts of charcoal or, in other words, 137℔. of charcoal are required for the production of a little over two pounds of pure copper, which sells at about one rupee a pound.

Iron mines.

The iron ores found in Kumaon all belong to either of two varieties, the rhombohedral or the prismatic. The first is a peroxide of iron containing in its best defined type 70 per cent. of iron and 30 per cent. of oxygen. The workable ore, however, often contains earthy impurities which reduce the proportion so low as 50 per cent. of metal. This is the common species. A variety of this, known as red hæmatite, also occurs in many places, and frequently contains small grains of specular iron ore of a highly splendent lustre. At Rámgarh it passes into the variety known as scaly iron ore, consisting of loosely cohering glimmering particles of a steel-grey or iron-black colour, strongly soiling and feeling unctuous to the touch. Captain Herbert considers these beds connected with those at Dhaniya Kot on the Kosi. Both yield very good iron. The prismatic species or hydrated peroxide is only known to occur in the Chaugarkha pargana.

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[1] See Sel. Rec., N.-W P., III., N.S. p. 34, and Glean. in Science, I., 230; As. Res. XVIII. (1), 227 (Herbert); Traill and Batten, Statistics of Kumaon, Agra, 851.

Kumaon mines.

The following are the principal iron mines in Kumaon. In Patti Agar of the Rámgarh pargana, as noted, the iron is of the species known as scaly, somewhat laminated in structure, slightly micaceous, and influencing the magnetic needle. The names of the principal mines are the Lúsgani, Nathúa Kán, Gulla and Sathúnga mines, the last of which has a rich hæmatite. In Patti Rámgarh, also, there are several mines that are largely worked. For the first 18 years of British rule these mines were leased to the headman of the Agaris at a nominal rent,[1] which up to 1826 included all the iron mines in Kumaon. In 1833 the mining industry in Rámgarh received its first check in the emigration of the miners to Khetsári in Páli, and has never since recovered its early importance. In the Chaugarkha pargana, the ore of the Muniya mine in Patti Lakhanpur is of the prismatic species. It is of two varieties, the ochry and compact. The former sometimes contains octahedral crystals and magnetic iron ore, and in the neighbourhood of the mine on the summit of a small hill there occur rolled pieces consisting of grains of quartz and small octahedral crystals of this mineral cemented together. These pieces are magnets, and have each two poles. The ores, too, contain manganese in notable proportion, and would consequently afford a very good steel; as it is to the alloy of this metal that the superiority of the steel manufactured from brown ore is attributed. In Patti Dárun there are mines at Digarhia and Jhiratoli of the same nature; in Rangor Patti at Jalal and Digarhia; in Patti Kharáhi at Loh. A specimen of iron ore brought from the neighbourhood of Milam, called by the natives of Malla Juhár '*baldánga*,' seems a crystalline variety of red hæmatite. It is used there for a red dye, the colour being extracted by rubbing the stone on a hard surface while wet.

Giwar mines.

The mines of Patti Giwar in pargana Páli are found at Chiteli, Sirauli, Khetsári, Simalkhet, Gudi, Bailgaon, Bonigarh, and close by at Mehalchauri and Tilwára. The valley in which the iron is produced runs nearly north and south, and extends from Dwárahát on the south to Pandúa

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[1] To Government, 21th December, 1833.

Khal on the north. It is formed by the rivers Kotlar and Khetsári, both flowing into the Rámganga, the bed of the former being about nine miles long, and that of the latter six miles. The ores lie on the east side of the valley and occur along a range of hills about thirteen miles in extent. The Simalkhet mine[1] is the largest, and has four entrances penetrating upwards of 350 feet into the mountain. The ores here consist of red hæmatite of a good quality in a gangue of clay slate branching in every direction and at all angles. The lodes range from 3′ to 18′ in width and 2½′ to 15′ in height, the average being from 3′ to 5′ by 4′ to 6′. There is no water, and the surrounding rock is compact, requiring few supports.

In Sayalgarh of pargana Kotauli there is some iron ore not at present worked. At Manglalekh in Talla Rao the ore is much esteemed for its quality, and is raised in some quantity. At Dehchauri, Rámgarh, and Khurpa Tál the mines are in the hands of the Kumaon Iron Works Company. The Lugthan mine is in Malla Katyúr, and there is another in Baraon Patti in pargana Gangoli. The burrows at Khairna are now unworked, likewise those at Simalkha and Uchakot.

Garhwál iron mines.

In the Garhwál district the iron mines in Patti Painkhanda exhibit specimens of granular iron pyrites imbedded in veins of quartz which occur in a dark-greyish talcose schist. They are apparently not very rich in ore. In Patti Síli Chandpur the Rajbúnga mine gives a rich hæmatite which is slightly attracted by the needle, and is still worked. The Khúsh mine in the same patti gives a micaceous ore, scaling off easily and showing minute crystals resembling garnets on the edges of some specimens. The adjacent beds seem to be chloritic schists; this ore affects the needle. In Taili Chandpur magnetic ore is found with hæmatite, and a specimen from Patti Talli Kálíphát resembles specular iron ore.

Nágpur mines.

Specimens from the Búkhanda mine in Patti Bichhla Nágpur are also of a micaceous nature, and seem to contain in parts minute crystals of quartz and pyrites, otherwise they much resemble graphite, and soil the fingers when touched. They do not influence the compass needle. The Jákhtoli mine in the same patti give an ore which

[1] III., Sel. Rec., N.-W. P., 23.

is probably a clay ironstone. It is of a light coffee colour and of little specific gravity. The Gilot mine close by gives an ore of a similar quality. In Malla Nágpur the ore is probably hæmatite. A vein of iron pyrites runs along the Alaknanda in this patti near the village of Hath. The people call them '*sona ke pathar*,' or gold stone, and sell them to the pilgrims to Badrináth at high rates. The stones, in the form of powder, are used as an orpiment, and the stone itself as a flint. A specimen from Nágpur itself is probably a carbonate of iron.

Dasauli and Bachhansyún.

The Mok mine in Patti Malli Dasauli yields an ore of which specimens appear to be magnetic, rich in metal, black in colour and crystalline, and laminated in structure. It possesses highly magnetic properties. The Charbang mine in the same locality is of a similar character, very rich in iron, and, according to Mr. Lawder, exhibits its polarity in the direction of the planes of lamination. The Dúngara mine in Patti Bachhansyún gives specimens which may possibly be an earthy hydrated oxide of iron. Its colour varies from ochry to dusky black, streak the same. It is of little specific gravity, the clay seemingly predominating. The iron of Bachhansyún, however, has a wide reputation for hardness and toughness. Sledge-hammers (*gan*) made from it have been found to last out those of the best English metal.

Iriya Kot.

The ore of Pípali mine in Patti Iriya Kot is probably a hydrous form of sesqui-oxide of iron, the clay largely predominating. The Danda Toli mine in the same patti seems to give an argillaceous variety of brown hæmatite. Lohba affords a rich hæmatite, raised in large quantities. The Chalya mine in Patti Painún gives a hard and brittle ore possessing the iron-black colour and metallic lustre of magnetic iron, but specimens of it failed to affect the compass needle in the manner characteristic of that ore. It may possibly on analysis be found to contain manganese.

Lead.

The deposits of lead are fairly numerous. The ore is found at Táchhíra in pargana Dhanpur mixed with a little silver. A large mine also existed at Ghirti in the snowy range between Milam and Níti, but this has lately been closed by a landslip. The mines at Ralum and Banskum on the banks of the Gori river and at Baidli Baghir are unworked. The ore is galena; and the matrix is silex, with varying proportions of feldspar and calcspar. The Nágpur mine is a fair one, but somewhat inaccessible. Near the Gaul mine in Patti Kharáhi and at Sor Gurang copper mines there are deposits of lead ore. The former is a galena traversing a silicious limestone, but neither are regularly worked. When the villagers require lead they burn the rock, and the lead, more or less sulphuretted, trickles from the crevices. A large nodule of lead, the size of an eighteen-pound shot, was found in Patti Maundarsyún, on the banks of the Nayár river. It consisted of pure galena, but though search was made no more could be discovered. In Jaunsár there are mines at Maiyár and Borela on the left bank of the Tons river and at Aiyár on the right bank. At Maiyár and Aiyár the matrix is clay slate, and at Borela, limestone supposed to be a bed in the clay slate.[1] The revenue from these mines is now nominal.

Arsenic.

Yellow arsenic, known as *haritál*, is found in the northern parts of Kumaon, near Múnsyári. A small portion is brought down every year by the Bhotiyas for sale at the Bageswar fair in January.

Lignite.

Indications of lignite appear near Ránibágh close to Haldwáni, the Barakheri pass near Bhamauri, and in the streams of the sub-Himálaya near Najíbabad in the Bijnor district. They do not give promise of any workable fuel, and, judging from the experience obtained in other parts of the hills, it is questionable whether any lignite deposits will ever be discovered of such extent and quality as to repay the expense of mining them. An analysis of a specimen of the Ránibágh lignite gave carbon 60·0, volatile matter 36·4, ash 3·6. The percentage of ash, however, contrasts favourably with Bengal coal.[2] Traces of a true peat are found at Bhím Tál. In 1833 Mr. E. Ravenshaw reported[3] the existence of coal in the bed of the Dhela river near Láldhang in Garhwál, where it occurred in thin seams varying from one inch to four inches broad. Similar traces were discovered in the beds of the Chala and Phika streams, but none of any commercial value. The specimens received in Calcutta were nearly all of the same character, "strongly impregnated with sulphuret of iron which forms their fibres, streaking some of them and passes into thick masses of pyrites, decomposing in others. A clean lump had a specific gravity of 1·968 in consequence, and the residual ash was principally iron oxide."

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[1] Gleanings in Science, I., 230. [2] As. Res., XVI., 387, 397. [3] J A. S. Ben., II., 264.

Graphite.

Graphite[1] (plumbago) crops out at the Kalimatiya hill to the north of Almora and on the spur of Banini Devi facing Almora on the Lohughát road. In 1850, specimens were sent to England and subjected to examination, when it was found that it could be made serviceable as graphite. Excavations were also made by Major Drummond at Garjoli near Balti, and Palsími, about three miles from Balti and the same eastward of Almora. The following is the report of Mr. Rose, the mineralogist who tested the specimens sent from Almora :—" Graphite is applied to several purposes. When very fine, compact, and of a sufficient cohesion, it is cut up for drawing-pencils. When the texture is loose, or it is otherwise of inferior quality, it is ground down and deprived of foreign substances by washing, as ores of metals are prepared for smelting. The powder thus purified is then used for various purposes, such as crucibles (being refractory or infusible by heat) for burning iron, and reducing the friction of machinery. A new method is now adopted for making artificial pencils, which are scarcely if at all inferior to those sawn out of the finest blocks. The dust of such fine material as your specimens Nos. 4, 8, and particularly No. 10, properly prepared, is subjected to vast hydraulic pressure (several hundred tons), and thus acquires the compactness and solidity necessary for the best purposes. The best kinds of graphite may be known by a pale lead-blue colour, high lustre, unctuosity, and inferior specific gravity. The first nine specimens will answer for pencils, most of them sufficiently pure and compact to be divided for that purpose. All the varieties sent may be used, even No. 13, though connected with much matrix, as it can be deprived of this by grinding and washing. All the varieties of this substance must continue in demand and bring remunerative prices if the expense of mining and conveyance should not be too great." It is also found in Patti Lohba of Garhwál on the Karnprayág road, and is there used as a dye.

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[1] See, further, Gleanings in Science, III., 280; J. A. S., XXIV., 203; In. Rec. (H. D.), XVII., 58. Rec., N.-W. P., III., N. S., 371.

Sulphur.

Sulphur is found both in Kumaon and Garhwál. In the former district it occurs in the tract called Múnsyári, and mechanically mixed with carbonate of lime in the beds of the Rámganga and Ganjiya rivers. It is also found as green sulphate of iron, and could be obtained in any quantity from the iron pyrites of the copper mines. There are also some sulphureous springs, as those at Naini Tal, Nargoli, and Káthgodám. There are two sulphur springs in Garhwál: the first lies close to the snowy range to the north-east of the temple of Madh Maheswar in pargana Nágpur; the other is on the left bank of the Biri river, two miles above its junction with the Alaknanda. The water of this last is so very strongly impregnated that its existence can be discovered by the smell long before arriving at the spring itself. Neither are made use of any way. Sulphur is also found in the galleries of the lead mines at Maiyár on the Tons in Jaunsár.

Borax.

Borax or tincal, a native saline compound of boracic acid and soda. The borax and salt fields of Gnari or Húndes, *lhá-lhaka* or *lháli-lháka*, lie to the north of Bongbwa Tál, across mountains that round the north-east side of the valley of the Shajan river, parallel to the Gangri range, and in the eastern part of the Zjang of Rohtoh (Rudukh) and at the Chapukani lake. The two salts are obtained from different spots in the same vicinity, and are both worked in the same way by lixiviation from the earth taken from the surface of the ground in which the salts are developed by natural efflorescence. These salt fields are open to all who choose to adventure their labour in them on payment of one-tenth of the produce to the Lhassa Government, who have an excise establishment on the spot.[1] The borax is collected from June to September and sold at the different fairs—Ganpa, Gartoh, Sibilam, Chájna, Taklakhar, Dabakhar. It is brought down by the Bhotiya traders and purchased by the merchants of Rámnagar, where it is refined. The process is as follows:—The borax is pounded and placed in shallow tubes, and then covered with water to the extent of a few inches; to this is added a solution of about two pounds of lime dissolved in two parts of water, for every ten maunds (820 pounds) of borax, and the whole mass is well stirred every six hours. Next day it is drained on sieves or cloth, and after this is again dissolved in 2½ times its weight of boiling water, and about sixteen pounds of lime added for the above quantity. It is then filtered, evaporation takes place, and subsequently it is crystallized in funnel-shaped vessels, usually of *kansa*, an alloy of copper and zinc or lead. The loss in weight is about 20 per cent. Borax is used in medicine and the arts. Dry borax acts on the metallic oxides at a high temperature, melting and vitrifying them into beautiful coloured glasses. It is also used as a flux for soldering in goldsmith's work and as a varnish combined with shell-lac. Its principal use is, however, in the manufacture of coloured glass, enamel, and glazed substances.[1]

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[1] Strachey: J. A. S. Ben., XVII. (2), 67.

Gypsum.

Gypsum is found in pargana Chhakháta. Perhaps the best bed is near the Nihál bridge on the road between Káládhúngi and Naini Tál. In 1850 the late Mr. Tregear, of the Bareilly College, made some very good plaster of Paris from it, which might be found useful in external plastering, as it has the property of expanding on cooling. Gypsum is found in Garhwál, on the banks of the Alaknanda near Panai and Nagrasu. There is also a dark-green variety which the people sometimes make into saucers and bowls.[2] Captain P. T. Cautley noticed[3] the occurrence of gypsum at Sansardhára and Salkot near Dehra and described its appearance and origin, which was further discussed by the Rev. R. Everest, but these papers have now little practical value.[4]

Soapstone.

A white saponaceous stone resembling and used for the same purpose as pipeclay is produced in many places. In Garhwál various vessels are turned from it, which when polished have the appearance of marble. They retain liquid, but being extremely brittle are little used.

Asbestos.

Asbestos has lately been discovered in a hill to the north of and at a short distance from Ukhimath in Garhwál. It is said to be of very good quality, but it is too far inland to be profitably worked. The people use it medicinally for dressing wounds and burns, and as a wick for oil-lamps, but it may yet be turned to a profitable account as a packing for steam-joints and the like.

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[1] Ure, I., 381. [2] As. Res., XVIII, (1), p. 216. [3] J. A. S. Ben., I., 289. [4] *Ibid*, 150, and Sherwill on Darjiling gypsum, *ibid*, XXI., 538.

Silajít.

Silajít[1] or *Salajít*, a native sulphate of alumina, is found both in Kumaon, Nepál and parganas Painkhanda and Nágpur in Garhwál. It is much sought after and used as a dressing for wounds. It occurs in small light lumps, colour brownish white, externally anhydrous, internally semi-crystalline, fracture slightly fibrous, with a lustre resembling asbestos, porous, containing small cavities lined with scarcely perceptible needle-like crystals, adheres a little to the tongue. Taste acidulous saline, soluble in twice its weight of distilled water, friable. Mr. Stevenson's analysis[2] gives as its component parts : sulphate of alumina, 95 ; peroxide of iron, 3 ; insoluble matter (silex), 1, and loss, 1. This analysis would appear to point to a specimen of greater purity than those commonly met with in the bazars which, as a rule, have seldom more than 66 per cent. of sulphate of alumina. The lumps generally have an admixture of red sand and frequently portions of micaceous stone are found embedded in them. Some of them have the smooth surfaces of stalactites and are not unlike those deposits. All are readily soluble in water, and when touched with the tongue give the taste of common alum. Dr. Campbell has described[3] the Nepálese trade in Salajít.

Limestone.

Limestone is found all over the division, both in immense masses exhibiting various shades of colour and structure, and as local tufa deposits. There are three distinct ranges of limestone hills in Garhwál : the first north of the Alaknanda in Nágpur, the second running from Lohba Patti to the Pindar, and again to the Alaknanda in Patti Bachhansyún, and the third running parallel to the plains and south of the Nayár river. There are also small patches of limestone scattered throughout the district, but not in such large quantities as in the abovementioned ranges. Lime is manufactured at Naini Tal, at Jyúli in the Kharáhi range, half-way between Bágeswar and Almora, at Chitoli, north of Dwárahát, at Simalkha, Baitálghát, and Dhikuli for Ránikhet, and on the new cart-road to Rámnagar. Lime is also made in Boraran, Sor, Síra, Dhyánirao, and Charál. Two kinds of limestone are used in the Tarái district, the one being obtained from the quarries at the foot of the Kumaon hills, which give by far the best kind of lime; the other is the tufa deposit obtained in the small nálas of the tract itself; this latter kind, however, is of a very inferior quality. First-class limestone costs at the quarries five to eight rupees per 100 maunds; the tax levied by the Forest Department is eight rupees on that amount, and cartage may be averaged at half a rupee per mile for 100 maunds. Thus the stone is landed at most points in the district for 30 rupees per 100 maunds, and including the expense of burning, a maund of lime costs 10 to 12 annas. This lime will bear two or three portions of pounded brick or *surki*. Second-class lime ready for use now costs 25 rupees, and delivered in Naini Tál, 50-100 rupees per 100 maunds; it will, however, only bear a proportion of one part of pounded brick to two parts of lime.

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[1] Derived from '*sila*,' a stone, and '*jit*,' principle or essence. [2] J. A. S., Ben., II. 321. [3] J. A. S., Ben., II., 482.

Building stone.

Good building stone can be procured in most parts of the hills. At Almora fine-grained, evenly-bedded quartzites and mica-schist form the hill itself, and supply material not to be excelled for durability and facility of dressing. Mica-schist seems to form the principal beds for some distance to the east and west of Almora, reaching to Dwárahát and Mási on the west, Páli, Ránikhet, Síyáhi Devi, Dol, and towards Káli Kumaun to the east, and also in the formation of the Jageswar and Binsar ranges to the north. At Naini Tál the stones used are limestone and clay schist. At Ránikhet a pale-coloured gneiss forms both a handsome and a lasting building stone having the property of hardening by exposure. Sandstone is abundantly found in the lower hills. Gneiss and chlorite-schists are used frequently as building stones in the district. In the Bhábar split boulders are found to answer the purpose of bricks. The Tarái is the only portion of the Kumaon division where bricks are extensively used for building purposes. Nine-inch bricks cost about Rs. 750 per lakh, and the small native bricks Rs. 100. Stone is sometimes carted from the foot of the hills for the better kind of work, but owing to the great expense is, so far as possible, dispensed with.

Roofing slate.

At Chiteli near Dwárahát there are roofing-slate quarries, now unworked; also at Dhári in the Bel Patti of Gangoli; in Borarao Patti, Salt Patti, and at Naini Tál. In Lohba of Garhwál the thin dark-blue slate is procurable, but these last appear to be much inferior to the Chiteli quarry.

Alum.

Alum, known as *phitkari*, is found in different parts of the province, and in abundance in the aluminous shales near Ják village, on the road from Naini Tál to Khairna and as an efflorescence on the micaceous schist in the bed of the Kosi below Almora. The shales contain minute particles of pyrites disseminated throughout their mass, which on becoming decomposed promote the formation of alum and the lixiviation produced by water leaves an encrustation of alum on the rock. A dark-coloured talc called *jalposhi* is exported to the plains and used as a tonic and febrifuge in medicine. In the neighbourhood of Kotgaon and Giwarsiu near Paori in Garhwál a bitumen or mineral resin is found.

There is no doubt but that in both quantity and quality the metalliferous deposits in this division are good, but the absence of coal and the competition of sea-borne metal have hitherto rendered mining an unproductive speculation, nor does there seem any probability of it attaining any important position among the industries of the province.

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29 Fossil remains of the smaller carnivora from the Sub-Himálaya, by Lieutenants Baker and Durand. *Ibid*, 585.

30. Notice of the skull (fragment) of a gigantic fossil batrachian from the Nahan field, by Dr. T Cantor. *Ibid*, VI., 538.

31. Note on the occurrence of fossil bones in the Siwálik range eastward of Hardwár, by Dr. H. Falconer. *Ibid*, VI., 233.

32. Note on a fossil ruminant species allied to Giraffidæ in the Sewálik hills, by Captain P. T Cautley. *Ibid*, VII., 658.

33. Note relating to Siwálik fauna, by H. B. Medlicott *Ibid*, XXXIV. ii., 63.

34. A sketch of the history of the fossil vertebrata of India, by R. Lydekker. *Ibid*, XLIX., ii., 8.

35. Fauna antiqua Sivalensis, by Falconer and Cautley. London, 1846-49-66.

36. Palæontological Memoirs and notes of H. Falconer, by C. Murchison. London, 1868.

37. Palæontologia Indica, published by the Geological Survey, Calcutta

38. Memoirs of the Geological Survey of India, by the same.

39. Records of the Geological Survey of India, by the same.

CHAPTER VII.

SCIENTIFIC BOTANY.

CONTENTS

A list of the *flora* of Garhwál, Jaunsar-Báwar and the Dehra Dún, by Dr. King. Tract to which the list refers. The Siwáliks. Sub-Siwálik tract. Dehra Dún. Himálayan tract. Characteristic vegetation from the plains to Mussooree. From Mussooree northwards. A list of the *flora* of Kumaon, and the Kumaon Bhábar, by Dr. Watson.

LIST[1] OF THE PLANTS OF GARHWÁL, JAUNSÁR-BÁWAR AND THE DEHRA DÚN.

Tract to which this list refers.

THE tract of country of which the vegetation is to be considered in the following pages presents very varied conditions in respect of physical configuration, soil, and climate. Its boundaries are—on the west the river Tons, a tributary of the Jumna, and on the east the Bhágirathi branch of the Ganges; on the north the snowy range of the Himálaya, and on the south the Siwálik range.

Siwáliks.

The Siwáliks run parallel to the Himálaya, and are separated from the latter by the Dehra Dún, a flat valley having an elevation of from 1,800 to 2,250 feet above the level of the sea. The highest peaks of the Siwáliks do not rise much above 3,000 feet, and the majority are much lower, but their outline against the sky is jagged and picturesque in the extreme, and the part of them with which we have to deal is about seven miles wide. Their southern slopes are ploughed by the force of the south-western monsoon into numerous deep narrow valleys, and the steeply scarped cliffs have a singularly bold beauty, totally different from anything to be seen in the outer parts of the Himálaya behind them. On their northern aspect, the Siwáliks slope gently into the valley of the Dún, and the scenery, though beautiful, is tamer than on the southern side. The rainfall on the range during the south-west monsoon is about 60 inches, but from the porous character of the soil and the steepness of the slopes, water drains off with extraordinary rapidity. The drainage passes away by innumerable channels, which, except for a few days in the year, are wide wastes of dry gravel and boulders. After each heavy shower these suddenly become filled with rushing torrents, which subside as speedily as they rose. Except during the rainy season, the range is very dry, and water is so scarce as to make it almost uninhabitable.

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[1] This list has been kindly prepared by Mr. G. King, M.B., F. L. S., Director of the Royal Botanical Gardens, Calcutta, for this work.

Sub-Siwálik tract.

Where the Siwáliks merge into the plains on the southern side, there are tracts of forest and grass equivalent to those covering the Bhábar and Tarái of the Himálaya in the districts where there is no Siwálik range. The vegetation of the sub-Siwálik belts is to a great extent but a reproduction in miniature of that of the latter. The flora of the southern face of the Siwáliks comprises many plants of the plains, with the addition of such species as *Hypericum cernuum* and *Cochlospermum Gossypium*. Perhaps the most striking tree found in the Siwáliks is the long-leaved pine *(Pinus longifolia)*, a Himálayan species, for which the Siwáliks form an outlying station. A large proportion of the arboreal vegetation of the Siwáliks consists of species which occur both on the lower slopes of the Himálaya and on the hilly districts of central and southern India, thus affording a good illustration of the width of distribution of Indian plants. As examples may be mentioned *Bombax malabaricum*, *Buchanania latifolia*, *Spondias mangifera*, *Boswellia serrata*, *Garuga pinnata*, *Spatholobus Roxburghii*, *Albizzia stipulata*, *Anogeissus latifolia*, *Ulmus integrifolia*, and others. Epiphytal orchids are absent, and ferns are but few in the Siwáliks. One labiate plant *(Eremostachys superba)* is confined to one or two spots in the Siwáliks, and is one of the best examples known to me in India of a truly local plant. Sál *(Shorea robusta)* of very stunted growth is abundant in the southern sub-Siwálik tract and on both sides of the range, as also over the whole of the Dún. This tree is here near its western limit; a little way to the west of the Jumna it disappears altogether.

Dehra Dún.

The Dehra Dún is a charming valley. The Siwáliks on the south shut it in from the plains, and, until recently, not only most effectually protected it from the hot winds in summer, but gave it a higher winter temperature than the plains outside. The extensive and ruthless clearances of the Siwálik forest of recent years are, however, believed (and apparently with good reason) to have caused an increase of the summer temperature of the Dún. The soil of the Dún consists chiefly of sandstone débris washed down from the Himálaya. The drainage is excellent, especially near the base of the Himálaya where the larger débris has been deposited, and the water level is everywhere far below the surface. The drainage water passes off by the Asan into the river Jumna, and by the Son and Súswa into the Ganges. The watershed of these streams runs across the valley in the line of the station of Dehra. The rainfall is about 80 inches, but, although only a small proportion of this total falls during any other than the rainy season, vegetation is kept wonderfully green during the whole year by the moisture prevalent in the atmosphere. Formerly the greater part of the Dún was covered by forest, of which the prevailing tree was *sál*, but of late years much of the forest has disappeared. A certain proportion of the cleared land has been devoted to village and some to tea cultivation, but much of it has been invaded by tall, coarse grasses useless alike to man and beast. Like the Siwáliks, the Dún is ravaged every hot season by fires from which the arboreal vegetation suffers to a degree which can only be appreciated by one who has lived in the forest. Unless these fires are checked with a high hand, the utter destruction of all forest vegetation in the Dún is but a question of time. The flora of the Dún presents an interesting mixture of species common on the plains outside, and of plants from the lower hills. Notable amongst the latter are the pretty little *Gentiana pedicellata*, and in the rains, here and there, *Platystemma violoides;* whilst amongst shrubs and climbing plants *Lespedeza*, *Indigofera pulchella*, *Jasminum pubescens*, and *Combretum decandrum* are perhaps the most noteworthy. The dense canebrakes of the Tarái and Bhábar of the trans-Gangetic sub-Himálayan tract are represented in the Dún by a few patches of a single species *(Calamus Royleanus)*, and this is not found westward of the Nálapani swamp, three miles from the station of Dehra. Epiphytal *Scitamineæ* are unknown in the Dún: a few orchids, however, occur, the most prominent among which are *Aerides affine* and *odoratum*, *Saccolabium Gharwalicum*, and *Oberonia iridifolia*. *Peperomia reflexa* is found here and there on trees in damp spots, and there are some epiphytal ferns, such as *Polypodium lineare*.

Himálayan tract.

The remainder of the region under review consists of a large irregularly shaped tract of the Himálaya proper, narrowed at its southern limit, but expanding towards the snowy range, part of which it includes. The physical features of this area are so varied that it would be out of place to attempt to describe them here. It must suffice to remind the reader that, while the lower and outer ranges have a climate not very different from that of the plains of India, the higher peaks, rising as they do to 18,000 feet above the sea-level, are covered with perpetual snow. As regards vegetation, the tract may be divided into three zones: the *sub-tropical* covering the slopes of the lower and outer hills, and following the courses of the deep hot valleys far into the interior of the range; the *temperate* covering the middle elevations; and the *arctic* confined to the greater heights and bounded on the north by the snow line itself. The transition between these zones is gradual. In consequence mainly of its greater distance from the sea, the rainfall of the western Himálaya is much less than that of the eastern part of the chain. But not only does the climate steadily increase in dryness from east to west, but the rainfall on the outer ranges is much heavier than in the interior. At Mussooree, for example, it amounts to about 80 inches, while at Harsíl, in the northern end of the Bhágirathi valley, the rainy season is represented by a short period of misty weather, and actual showers are but rare. The intervening country has a rainfall graduated between these two extremes.

Characteristic vegetation from the plains to Mussooree.

In ascending the Himálaya from the Dún to Mussooree, new species meet the eye step by step. Among trees, *Bauhinia retusa*, *Engelhardtia Colebrookiana*, *Rhododendron arboreum*, and the Oaks are the most striking new forms. *Pinus longifolia*, already met with on the Siwáliks, becomes abundant. Berberries, various *Bœhmerias* and other *Urticaceæ*, *Hamiltonia*, *Leptodermis*, various species of *Viburnum*, *Clematis* and *Rosa* at first mingle with, and finally replace, the sub-arboreal woody vegetation of the base of the hills. During the rains the change in vegetation, as one ascends, is even more striking. On steep banks and faces of rock by the roadside the eye is delighted by such charming species as *Chirita bifolia*, *Didymocarpus aromaticus* and *macrophyllus*, *Platystemma violoides*, *Selaginella Jacquemontii*, *Androsace sarmentosa* and *incisa*, *Fragaria indica*, *Saxifraga ligulata*, *Argostemma sarmentosum*, and *Begonia picta*. Ferns too abound both on the ground and on trees. A few epiphytal orchids, the *Peperomia* already mentioned, and *Remusatia vivipara* are found on the trees. But the epiphytal vegetation here is but poor and scanty when compared with that of the eastern Himálaya, thus illustrating in the most forcible way the comparative dryness of the atmosphere throughout the year. On these lower slopes a dwarf palm *(Phœnix acaulis)* and a pretty little bamboo called *ringál (Arundinaria falcata)* are not unfrequent; a larger species of bamboo *(Dendrocalamus strictus)*, which occurs in plenty, is common also in the Dún and Siwáliks.

At the level of Mussooree temperate forms begin to appear and the botanist revels in plants belonging to such familiar European genera as *Ranunculus*, *Thalictrum*, *Anemone*, *Geranium*, *Potentilla*, *Rubus*, *Rumex*, *Pedicularis*, and *Habenaria*. Umbelliferous plants and *Polygonaceæ* are common, and terrestrial orchids of northern forms are not unfrequent during the rains. As the higher elevations are approached, the vegetation assumes the characteristic Alpine type. *Astragali*, *Corydalis* of different species, numerous *Caryophylleæ*, Saxifrages, *Sedums*, Primroses, Gentians and *Carices* abound, and in the carpet of rich green grass are here and there studded the magnificent Aconites, *Meconopsis* and *Pæonia emodi*. Prominent amongst the forest vegetation are the stately cedar, the rigid silver spruce and the graceful weeping pine. The twisted cypress towers aloft, and the solemn yew stretches out its sombre arms. Lichens, mosses and *fungi* abound, and *algæ* are numerous in the streams.

From Mussooree northwards.

The following list of the flowering plants and ferns does not profess to be complete. It contains only the names of species of which there are specimens in the Herbarium of the Calcutta Botanic Garden, or in my own collection. The former Herbarium ought to contain every species occurring within the British Empire in India. It has, however, been brought together principally by desultory private effort, and is consequently unequal and defective. As a rule, there are included in this list indigenous plants only; the few others that occur are marked either as *naturalized* or *introduced*. Certain plants which are believed to be natives, but which are found only in cultivation, are marked as *cultivated.* For much assistance in revising this list I am indebted to Mr. W. Waterfield, C. S.

Natural Order 1.—*Ranunculaceæ.*

Clematis Nepaulensis, DC.
,, montana, Ham.
,, barbellata, Edgw.
,, grata, Wall
,, Gouriana, Roxb.
,, puberula, Hf. & T.
,, graveolens, Lindl.
,, orientalis, L.
,, nutans, Royle.
,, acuminata, DC.
,, connata, DC.
,, Buchananiana, DC.
Anemone vitifolia, Ham.
,, obtusiloba, Don.
,, rupestris, Wall.
,, rivularis, Ham.
,, polyanthes, Don.
,, narcissiflora. L.
,, tetrasepala, Royle.
,, elongata, Don.
Thalictrum elegans, Wall.
,, platycarpum, Hf. & T.
,, cultratum, Wall.
,, Chelidoni, Hf. & T.
,, reniforme, Wall.
,, pauciflorum, Royle.
,, rostellatum, Hf. & T.
,, Punduanum, Wall.
,, saniculæforme, DC.
,, Javanicum, Bl.
,, foliolosum, DC.
,, minus, L.
Callianthemum cachemirianum, Camb.
Adonis æstivalis, L.
Ranunculus aquatilis, L.
,, Lingua, L.
,, pulchellus, C. A. Mey.
,, lobatus, Jacquem.
,, hyperboreus, Rottb.
,, affinis, Br.
,, hirtellus, Royle.
,, sceleratus, L.
,, diffusus, DC.
,, lætus, Wall.
,, pensylvanicus, L.
,, arvensis, L.
Oxygraphis polypetala, Hf. & T.
Caltha palustris, L.
Trollius acaulis, Lindl.
Isopyrum thalictroides, L
,, grandiflorum, Fisch.
Nigella sativa, L. *naturalized.*
Aquilegia vulgaris, L.
Delphinium denudatum, Wall.
,, cœruleum, Jacquem.
,, elatum, L.
,, vestitum, Wall.

Natural Order 1.—*Ranunculaceæ*—(concluded).

Delphinium Cashmirianum, Royle
,, Ajacis, L., *introduced*
Aconitum Lycoctonum, L
,, palmatum, Don.
,, ferox, Wall.
,, Napellus, L.
,, heterophyllum, Wall.
Actæa spicata, L.
Cimicifuga fœtida, L.
Pæonia emodi, Wall.

Natural Order 2.—*Magnoliaceæ.*

Michelia Champaca, L., *introduced*
Schizandra grandiflora, Hf. & T.
,, propinqua, Hf. & T.

Natural Order 3.—*Anonaceæ.*

Miliusa velutina, Hf. & T.

Natural Order 4.—*Menispermaceæ.*

Tinospora cordifolia, Miers.
Cocculus laurifolius, DC.
,, villosus, DC.
Stephania elegans, Hf. & T.
,, rotunda, Lour.
Cissampelos Pareira, L.

Natural Order 5.—*Berberideæ.*

Holbœllia latifolia., Wall.
Berberis nepalensis, Spreng.
,, vulgaris, L.
,, aristata, DC.
,, Lycium, Royle.
,, asiatica, Roxb.
Podophyllum emodi, Wall.

Natural Order 6.—*Nymphæaceæ.*

Nelumbium speciosum, Willd., *introduced*
Nymphæa Lotus, L.

Natural Order 7.—*Papaveraceæ.*

Papaver somniferum, L., *cultivated.*
,, dubium, L.
Argemone mexicana, L., *naturalized.*
Meconopsis aculeata, Royle.
,, robusta, Hf. & T.
,, nepalensis, DC.
Stylophorum lactucoides B. & Hf.

Natural Order 8.—*Fumariaceæ.*

Dicentra Roylei, Hf. & T.
" scandens, Walp.
Corydalis rutæfolia, Sibth
" cachemiriana, Royle.
" crithmifolia, Royle.
" elegans, Wall
" *Govaniana*, Wall.
" sibirica, Pers
" cornuta, Royle
" chærophylla, DC.
" meifolia, Wall,
" flabellata, Edgw.
Fumaria parviflora, Lamk.

Natural Order 9.—*Cruciferæ.*

Nasturtium officinale, Br.
" palustre, DC.
" montanum, Wall.
Barbarea vulgaris, Br.
Arabis glabra, Crantz.
" alpina, L.
" amplexicaulis, Edgw.
Cardamine hirsuta, L.
" impatiens, L.
" macrophyla, Willd.
Allyssum canescens, DC.
Draba alpina, L.
" incana, L.
" lasiophylla, Royle.
" fladnitzensis, Wulf.
Sisymbrium mollissimum, C. A. Meyer.
" himalaicum, Hf & T.
" Thalianum, Gay & Monn.
" rupestre, Edgw.
" strictum, Hf & T.
" Wallichii, Hf. & T.
" Sophia, L
" Columnæ, Jacq.
" Alliaria, Scop
Eutrema primulæfolium, Hf. & T.
Erysimum hieracifolium, L.
" altaicum, C. A. Meyer.
" Thomsoni, Hf.
Braya rosea, Bunge.
Brassica nigra, Koch.
" campestris, L.
" juncea, Hf & T.
Eruca sativa, Lamk.
Capsella Bursa pastoris, Mœnch.
Lepidium sativum, L.
" Draba, L.
" capitatum, Hf. & T.
Megacarpæa polyandra, Benth.
Thlaspi arvense, L.
" alpestre, L.
Iberidella Andersoni, Hf. & T.
Raphanus sativus, L., *cultivated.*
Goldbachia lævigata, DC.
Chorispora tenella, DC.

Natural Order 10.—*Capparideæ.*

Cleome viscosa, L.
Gynandropsis pentaphylla, DC.

Natural Order 10.—*Capparideæ*—(concld.)

Mærua arenaria, Hf. & T.
Capparis spinosa, L.
" horrida, L. f.
Cratæva religiosa, Forst.

Natural Order 11.—*Violaceæ.*

Viola biflora, L.
" Patrinii, DC.
" serpens, Wall.
" kunawarensis, Royle.
Ionidium suffruticosum, Ging.

Natural Order 12.—*Bixineæ.*

Cochlospermum Gossypium, DC.
Flacourtia Ramontchi, L'Herit.
" sepiaria, Roxb
Xylosma longifolium, Clos.

Natural Order 13.—*Pittosporeæ.*

Pittosporum floribundum, W. & A.
" eriocarpum, Royle.

Natural Order 14.—*Polygaleæ.*

Polygala triphylla, Ham.
" crotalarioides, Ham.
" abyssinica, Fresen,
" leptalea, DC.
" persicariæfolia, DC.
" chinensis, L.
" sibirica, L.
Salomonia cantoniensis, Lour.

Natural Order 15.—*Caryophylleæ.*

Gypsophila cerastioides, Don.
Saponaria Vaccaria, L.
Silene inflata, Sm.
" conoidea, L.
" Falconeriana, Benth.
" Griffithii, Boiss.
" gallica, L.
" Moorcroftiana, Wall,
" Webbiana, Wall.
" Stracheyi, Edgw.
Cucubalus bacciferus, L.
Lychnis apetala, L.
" brachypetala, Hort. Berol.
" multicaulis, Wall.
" inflata, Wall.
" indica, Benth, *var.* fimbriata, Wall.
" nutans, Benth.
" pilosa, Edgw.
Cerastium dahuricum, Fisch.
" vulgatum, L.
" Thomsoni, Hf.
Stellaria crispata, Wall.
" paniculata, Edgw.
" semivestita, Edgw.

Natural Order 15.—Caryophylleæ— (concluded)

Stellaria aquatica, Scop.
,, media, L.
,, Webbiana, Wall.
,, latifolia, Benth.
,, longissima, Wall.
,, saxatilis, Ham.
,, glauca, With.
,, decumbens, Edgw.
Arenaria foliosa, Royle.
,, festucoides, Benth.
,, serpyllifolia, L.
,, orbiculata, Royle.
,, glanduligera, Edgw.
,, Stracheyi, Edgw.
,, holosteoides, Edgw.
,, Benthami, Edgw.
Sagina procumbens, L.
Spergula arvensis, L., in *fields.*
,, pentandra, L., *ditto.*
Drymaria cordata, Willd.
Polycarpaea corymbosa, Lamk.

Natural Order 16.—Portulaceæ.

Portulaca oleracea, L.

Natural Order 17.—Tamariscineæ

Tamarix gallica, L.
,, dioica, Roxb.
Myricaria germanica, Desv.
,, elegans, Royle.

Natural Order 18.—Elatineæ.

Bergia ammannioides, Roxb.

Natural Order 19.—Hypericineæ.

Hypericum cernuum, Roxb.
,, cordifolium, Chois.
,, lysimachioides, Wall.
,, patulum, Thunb.
,, perforatum, L.
,, elodeoides, Chois.
,, nepaulense, Chois.

Natural Order 20.—Ternstrœmiaceæ.

Eurya japonica, Thunb.
Actinidia callosa, Lindl.
Saurauja nepaulensis, DC.
Camellia Thea, Link. Tea, *introduced and cultivated.*

Natural Order 21.—Dipterocarpeæ

Shorea robusta, Gærtn., Sál.

Natural Order 22.—Malvaceæ.

Malva verticillata, L.
,, silvestris, L.
,, rotundifolia, L.
,, parviflora, L.
Sida rhombifolia, L.
,, cordifolia, L.
Abutilon polyandrum, Schl.
,, indicum, G. Don.
,, graveolens, W. & A.
Urena lobata, L.
,, repanda, Roxb.
Hibiscus Trionum, L.
,, furcatus, Roxb.
,, Solandra, L'Herit.
,, ficulneus, L.
,, pungens, Roxb.
,, Abelmoschus, L.
,, cancellatus, Roxb.
,, esculentus, L., *naturalised.*
Thespesia Lampas, Dalz. & Gibs.
Gossypium herbaceum, L., *introduced.*
Kydia calycina, Roxb.
Bombax malabaricum, DC.

Natural Order 23.—Sterculiaceæ

Sterculia villosa, Roxb.
,, Roxburghii, Wall.
,, fulgens, Wall.
Helicteres Isora, L.
Pterospermum acerifolium, Willd., *rare.*
Melochia corchorifolia, L.
Waltheria americana, L.
Abroma augusta, L., *probably introduced.*

Natural Order 24.—Tiliaceæ.

Grewia oppositifolia, Roxb.
,, vestita, Wall.
,, tiliæfolia, Vahl.
,, asiatica, L.
,, sapida, Roxb.
,, scabrophylla, Roxb.
,, polygama, Roxb.
,, lævigata, Vahl.
Corchorus fascicularis, Lamk.
,, acutangulus, Lamk.
Triumfetta pilosa, Roth.
,, rhomboidea, Jacq.
,, annua, L.

Natural Order 25.—Lineæ

Linum usitatissimum, L.
,, mysorense, Heyne.
Reinwardtia trigyna, Planch.

Natural Order 26.—Malpighiaceæ.

Hiptage Madablota, Gærtn.
Aspidopterys Wallichii, Hf.
,, nutans, Hf.

Natural Order 27.—*Zygophyllaceæ.*

Tribulus terrestris, L.

Natural Order 28.—*Geraniaceæ.*

Geranium palustre, L.
,, collinum, M. Bieb
,, Wallichianum, Sweet
,, nepalense, Sweet
,, polyanthes, Edgw. & Hf
,, rotundifolium, L
,, molle, L
,, Robertianum, L.
,, lucidum, L.
,, ocellatum, Camb
Oxalis corniculata, L
,, Acetosella, L
Biophytum sensitivum, DC.
,, Reinwardtii, Walp
Impatiens Roylei, Walp
,, Thomsoni, Hf
,, sulcata, Wall
,, amplexicaulis, Edgw
,, Balsamina, L., Majethi.
,, scabrida, DC.
,, bicornuta, Wall.
,, amphorata, Edgw.

Natural Order 29.—*Rutaceæ*

Pœnninghausenia albiflora, Reichb
Dictamnus albus, L.
Xanthoxylon alatum, Roxb
,, oxyphyllum Edgw
Toddalia aculeata, Pers.
Skimmia Laureola, Hf.
Glycosmis, pentaphylla, Corr.
Limonia acidissima, L.
Murraya exótica, L
,, Kœnigii, Spreng
Clausena pentaphylla, DC.
Citrus medica, L.
,, Aurantium, L.
Ægle Marmelos, Corr.
Feronia Elephantum, Corr.

Natural Order 30.—*Simarubeæ.*

Ailanthus excelsa, Roxb.
Picrasma quassioides, Benn.

Natural Order 31.—*Ochnaceæ.*

Ochna pumila, Ham.

Natural Order 32.—*Burseraceæ*

Boswellia serrata, Roxb.
Garuga pinnata, Roxb.

Natural Order 33.—*Meliaceæ.*

Melia Azedarách, L., Bakain
,, composita, Willd.
Azadirachta Indica, Juss., Nim
Cedrela serrata, Royle.
,, Toona, Roxb.

Natural Order 34.—*Olacineæ.*

Olax nana, Wall.

Natural Order 35.—*Ilicineæ.*

Ilex dipyrena, Wall
,, excelsa, Wall.
,, odorata, Ham

Natural Order 36.—*Celastrineæ.*

Euonymus pendulus, Wall,
,, echinatus, Wall.
,, grandiflorus, Wall
,, Hamiltonianus, Wall.
,, lacerus, Ham.
,, tingens, Wall
Celastrus paniculata, Willd., Malkagni.
Gymnosporia rufa, Wall
,, montana, Roxb.
,, Royleana, Wall.
Elæodendron glaucum, Pers.

Natural Order 37.—*Rhamneæ.*

Ventilago calyculata, Tulasne.
Zyzyphus Jujuba, Lamk.
,, Œnoplia, Mill.
,, vulgaris, Lamk.
,, xylopyra, Willd.
,, nummularia, W. & A.
,, oxyphylla, Edgw.
Berchemia floribunda, Wall
Rhamnus purpureus, Edgw
,, procumbens, Edgw.
,, virgatus, Roxb.
,, triqueter, Wall.
Sageretia oppositifolia, Brongn.
,, theezans, Brongn.
Scutia indica, Brong.
Gouania leptostachya, DC.
,, nepalensis, Wall
Hovenia dulcis, Thunb.

Natural Order 38.—*Ampelideæ.*

Vitis capreolata, Don.
,, latifolia, Roxb.
,, vinifera L., *introduced.*
,, Linnæi, Wall
,, adnata, Wall.
,, lanata, Roxb.
,, himalayana, Brand.
,, parvifolia, Roxb.
,, obtecta, Wall.
,, divaricata, Wall
Leea sambucina, Willd.
,, robusta, Roxb
,, alata, Edgw.
,, aspera, Wall

Natural Order 39.—*Sapindaceæ.*

Æsculus indica, Colebr.
Schleichera trijuga, Willd.
Sapindus trifoliatus, L.
,, Mukorossi, Gærtn., *probably introduced.*

Natural Order 39.—*Sapindaceæ*—(concluded).

Sapindus Danura, Voigt., *probably introduced.*
Acer oblongum, Wall.
,, cæsium, Wall.
,, lævigatum, Wall.
,, pictum, Thunb.
,, villosum, Wall.
,, caudatum, Wall.
Melianthus major., L., *introduced.*
Staphylea Emodi, Wall.

Natural Order 40.—*Sabiaceæ.*

Sabia paniculata, Edgw.
,, campanulata, Wall.
Meliosma simplicifolia, Bl.
,, dilleniæfolia, Bl

Natural Order 41.—*Anacardiaceæ.*

Rhus vernicifera, DC.
,, acuminata, DC.
,, semialata, DC.
,, Cotinus, L.
,, succedanea, L.
,, parviflora, Roxb.
Spondias Mangifera, Pers.
Mangifera indica, L.
Buchanania latifolia, Roxb.
Odina Wodier, Roxb.
Semecarpus Anacardium, L.

Natural Order 42.—*Coriarieæ.*

Coriaria nepalensis, Wall.

Natural Order 43.—*Moringeæ.*

Moringa pterygosperma, Gærtn.

Natural Order 44.—*Leguminosæ.*

Piptanthus nepalensis, Don.
Thermopsis barbata, Royle.
Crotalaria prostrata, Roxb.
,, alata, Roxb.
,, sericea, Retz.
,, juncea, L.
,, tetragona, Roxb.
,, albida, Heyne.
,, neglecta, W. & A.
Argyrolobium flaccidum, J. et S.
,, roseum, J. et S.
Parochetus communis, Ham.
Trigonella Fœnum-Græcum, L.
,, gracilis, Benth
Medicago lupulina, L.
,, laciniata, All
,, sativa, L., *cultivated.*
Melilotus parviflora, Desf.
,, alba, Lamk
,, officinalis, L.

Natural Order 44.—*Leguminosæ*—(continued).

Trifolium repens, L.
,, pratense, L.
Lotus corniculatus, L.
Indigofera linifolia, Retz.
,, trifoliata, L.
,, trita, L.
,, tinctoria, L.
,, pulchella, Roxb.
,, Dosua, Ham
,, atropurpurea, Ham.
,, hirsuta, L.
,, Gerardiana, Wall.
,, heterantha, Wall.
Tephrosia purpurea, Pers.
,, tenuis, Wall
Millettia auriculata, Baker.
Caragana brevispina, Royle.
Colutea nepalensis, Sims
Astragalus graveolens, Ham
,, trichocarpus, Grah.
,, adesmiæfolius, Benth.
,, leucocephalus, Grah.
,, hosackioides, Benth.
,, rhizanthus, Royle.
,, Webbianus, Grah.
,, multiceps, Wall
Oxytropis microphylla, DC.
Æschynomene indica, L.
Smithia sensitiva, Ait
,, ciliata, Royle.
Zornia diphylla, Pers.
Ougeinia dalbergioides, Benth.
Desmodium oxyphyllum, DC.
,, gangeticum, DC.
,, laxiflorum, DC.
,, gyrans, DC.
,, podocarpum, DC.
,, tiliæfolium, Don.
,, floribundum, G. Don.
,, concinnum, DC
,, polycarpum, DC.
,, parvifolium, DC.
,, triflorum, DC.
Uraria picta, Desv
,, lagopus, DC
,, lagopodioides, DC.
Alysicarpus vaginalis, DC.
,, bupleurifolius, DC.
Lespedeza elegans, Camb.
,, sericea, Miq
,, eriocarpa, DC
,, juncea, Pers.
Vicia sativa, L
,, rigidula, Royle.
,, hirsuta, Koch.
,, tenera, Grah
,, tenuifolia, Roth
,, tetrasperma, Mœnch.
Lens esculenta, Mœnch, *cultivated.*
Lathyrus sativus, L.
,, luteus, Bak.
,, Aphaca, L.

Natural Order 11.—*Leguminosæ*—(concld.)

Pisum sativum, L., *introduced.*
Abrus precatorius, L.
Clitoria Ternatea, L.
Dumasia villosa, DC.
Shuteria involucrata, W. & A.
Glycine Soja, S. et Z
Erythrina arborescens, Roxb.
„ resupinata, Roxb.
„ suberosa, Roxb.
Mucuna pruriens, DC.
„ atropurpurea, DC.
Butea frondosa, Roxb
Spatholobus Roxburghii, Benth.
Pueraria tuberosa, DC.
Phaseolus Mungo, L } *cultivated.*
„ aconitifolius, Jacq. } *cultivated.*
Vigna Catjang, End. } *cultivated.*
Dolichos Lablab, L. } *cultivated.*
Cajanus indicus, L. } *cultivated.*
Atylosia scarabæoides, Benth.
„ mollis, Benth.
Rhynchosia minima, DC.
„ Falconeri, Baker.
Flemingia semialata, Roxb.
„ strobilifera, R. Br.
„ vestita, Benth.
Dalbergia Sissoo Roxb.
„ lanceolaria, L.
„ hircina, Benth.
„ volubilis, Roxb.
Pongamia glabra, Vent.
Sophora mollis, Wall.
Cæsalpinia Bonducella, Flemm.
„ sepiaria, Roxb.
Cassia Fistula, L.
„ Tora, L.
„ occidentalis, L.
„ Absus, L.
„ pumila, Lamk.
„ Wallichiana, DC.
Bauhinia racemosa, Lamk.
„ variegata, L.
„ retusa, Roxb.
„ Vahlii, W. & A.
„ purpurea, L.
Mimosa rubicaulis, Lamk.
„ pudica, L. Sensitive plant, *naturlized*
Acacia Catechu, Willd
„ pennata, Willd.
„ cæsia, W and A.
„ Farnesiana, Willd, *naturalized.*
„ eburnea, Willd.
Albizzia lucida, Benth.
„ Lebbek, Benth.
„ odoratissima, Benth.
„ procera, Benth.
„ Julibrissin, Boiv.
„ stipulata, Boiv.

Natural Order 45.—*Rosaceæ.*

Prunus Puddum, Roxb.
„ Padus, L.

Natural Order 45.—*Rosacea*—(concld)

Prunus domestica, L. Alucha, Plum, *introduced.*
„ armeniaca L., Zard Alu, Apricot, *cultivated.*
Amygdalus persica, L , Aru, Peach, *introduced.*
Prinsepia utilis, Royle.
Spiræa canescens, Don.
„ callosa, Thunb
„ Kamtschatica, Pall ?
„ sorbifolia, L.
„ Aruncus, L
Rubus acuminatus, Sm.
„ paniculatus, Sm.
„ parvifolius, L.
„ concolor, Wall.
„ niveus, Wall.
„ fruticosus, L.
„ flavus, Ham.
„ lasiocarpus, Sm.
„ rosæfolius, Sm.
„ biflorus, Ham.
„ asper, Don.
Geum elatum, Wall.
Fragaria indica, Andr.
„ vesca, L
Agrimonia Eupatorium, Linn.
Potentilla fruticosa, L.
„ microphylla, Don.
„ multifida, L.
„ Leschenaultiana, Ser.
„ fulgens, Wall.
„ nepalensis, Hook
„ atrosanguinea, Lodd.
„ supina, L.
„ (Sibbaldia) procumbens, L.
Rosa Lyellii, Lindl.
„ moschata, Mill.
„ Brunonii, Lind.
„ macrophylla, Lind.
„ Webbiana, Wall.
„ sericea, Lind.
Pyrus Aria, Ehrh
„ baccata, L., Gwála Mehal.
„ variolosa, Wall, Mehal.
„ communis L , Nashpáti, Pear, *cultivated.*
„ Malus L., Seo, Apple, *cultivated.*
„ ursina, Wall.
„ foliolosa, Wall.
„ Cydonia, L., *introduced.*
Cratægus Pyracantha, Pers
Cotoneaster acuminata, Lindl.
„ microphylla, Wall
„ bacillaris, Wall.
„ nummularia, F. et M.

Natural Order 46 —*Saxifrageæ.*

Astilbe rivularis, Don.
Saxifraga ligulata, Wall.
„ Stracheyi, Hf. & T.
„ imbricata, Royle.

Natural Order 46.—Saxifrageæ—(concld.)

Saxifraga ramulosa, Wall.
,, granulata, L.
,, odontophylla, Willd.
,, micrantha, Edgw.
,, pallida, Wall.
,, flagellaris, Willd.
,, Brunonis, Wall.
,, filicaulis, Wall.
,, brachypoda, Don.
,, diversifolia, Wall.
,, Jacquemontiana, Dcne.
Chrysosplenium nepalense, Dcne.
Parnassia Wightiana, Wall.
,, nubicola, Wall.
Hydrangea altissima, Wall.
Deutzia corymbosa, R. Br.
,, staminea, R. Br.
Philadelphus coronarius, L.
Itea nutans, Royle.
Ribes Grossularia, L.
,, glaciale, Wall.
,, rubrum, L.
,, nigrum, L.

Natural Order 47.—Crassulaceæ

Tillæa pentandra, Royle
Crassula indica, Dcne
Bryophyllum, calycinum Salisb., *in gardens.*
Kalanchoe varians, Haw
Cotyledon Oreades, Benth et Hf.
Sedum crenulatum, Hf & T.
,, quadrifidum, Pall.
,, Himalense, Don.
,, crassipes, Wall.
,, elongatum, Wall
,, linearifolium, Royle.
,, pauciflorum, Edgw.
,, trifidum, Wall.
,, *rosulatum, Edgw.*
,, adenotrichum, Wall.
,, Ewersii, Ledeb
,, multicaule, Wall.
,, Rhodiola, DC.

Natural Order 48.—Droseraceæ.

Drosera peltata *Var.* lunata, Ham.

Natural Order 49.—Haloragaceæ.

Myriophyllum spicatum, L.

Natural Order 50.—Combretaceæ

Terminalia belerica, Roxb. Bahara.
,, Chebula, Retz., Har.
,, citrina, Roxb. Harira.
,, Arjuna, Bedd., Arjun.
,, tomentosa, Roxb. Saj.
Anogeissus latifolia, Wall.
Combretum decandrum, Roxb.

Natural Order 51.—Myrtaceæ.

Eugenia Jambolana, Lamk., Jáman.
,, caryophyllifolia, Lamk.
Careya arborea, Roxb.
Barringtonia acutangula, Gærtn.

Natural Order 52.—Melastomaceæ.

Osbeckia stellata, Don.
,, angustifolia, Don

Natural Order 53.—Lythraceæ

Ammannia rotundifolia, Ham
,, vesicatoria, Roxb.
Woodfordia floribunda, Salisb
Lawsonia alba Lamk., Mehndi, *gardens.*
Lagerstrœmia parviflora, Roxb
Punica Granatum, L., *wild and cultivated*

Natural Order 54.—Onagraceæ.

Epilobium tomentosum, Boiss
,, roseum, L.
Œnothera rosea, Sims., } *naturalized.*
,, sinuata, L., }
,, grandiflora, }
Circæa Lutetiana, L.
,, alpina, L.

Natural Order 55.—Samydaceæ.

Casearia tomentosa, Roxb.

Natural Order 56.—Cucurbitaceæ.

Trichosanthes cucumerina, L.
,, palmata, Roxb.
Luffa cylindrica, Naud
Cucumis Melo, L., *cultivated.*
,, *sativus, L.* ,,
,, Hardwickii, Royle.
Citrullus vulgaris, Schrad
Bryonia laciniosa, L.
Mukia scabrella, Arn
Zehneria umbellata, Thw.

Natural Order 57.—Begoniaceæ.

Begonia picta, Wall.
,, amœna, Wall.

Natural Order 58.—Datiscaceæ.

Datisca cannabina, L.

Natural Order 59.—Ficoideæ.

Trianthema pentandra, L.
,, crystallina, Vahl.
Mollugo hirta, Thunb.
,, pentaphylla, L.
,, Cerviana, Ser.

Natural Order 60.—*Umbelliferæ.*

Hydrocotyle asiatica, L.
Sanicula europæa, L.
Bupleurum tenue, Ham.
,, longicaule, Wall
,, Candollei, Wall.
,, falcatum, L
,, marginatum, Wall.
Apium graveolens, L , *introduced*
Carum Copticum, Benth et Hf. Ajwáin, *cultivated*
Aeronema tenerum, Edgw
Pimpinella diversifolia, DC.
Chærophyllum villosum, Wall.
Œnanthe stolonifera, Wall.
Selinum Candollei, Bth et Hf.
,, Brunonis, DC.
,, Govanianum, DC.
,, angelicoide. DC.
Heracleum candicans, Wall.
,, nepalense, Don.
Peucedanum graveolens, L. Sawa.
Coriandrum sativum, L., *cultivated.*
Daucus Carota, L , *cultivated.*
Torilis Anthriscus, Gmel.

Natural Order 61—*Araliaceæ.*

Aralia cachemirica, Dcne
Heteropanax fragrans, Seem.
Hedera Helix, L.
Heptapleurum venulosum, Seem.

Natural Order 62—*Cornaceæ.*

Marlea begoniæfolia, Roxb.
Cornus macrophylla, Wall.
,, oblonga, Wall.
,, capitata, Wall.
Alangium Lamarckii, Thw.

Natural Order 63 —*Caprifoliaceæ.*

Abelia triflora, R. Br.
Leycesteria formosa, Wall.
Lonicera Myrtillus, Hf & T.
,, parvifolia, Edgw.
,, purpurescens, Hf. & T.
,, hypoleuca, Dcne.
,, orientalis, Lamk.
,, alpigena, L.
,, heterophylla, Dcne.
,, angustifolia, Wall.
,, spinosa, Jacquem.
,, quinquelocularis, Hardw.
Viburnum cotinifolium, Don.
,, stellulatum, Wall.
,, integerrimum, Wall,
,, nervosum, Don.
,, coriaceum, Bl.

Natural Order 64.—*Rubiaceæ.*

Adina cordifolia, Benth et Hf.
Stephegyne parvifolia, Benth et Hf.
Hymenodictyon excelsum, Wall.

Natural Order 64—*Rubiaceæ*—(concld)

Wendlandia exserta, DC.
,, puberula, DC.
Argostemma sarmentosum, Wall.
, verticillatum, Wall.
Hedyotis Burmanniana, R. Br.
,, aspera, Heyne.
,, brachypoda, DC.
,, gracilis, Wall.
Randia dumetorum, Lamk.
,, tetrasperma, Roxb
,, uliginosa, DC.
Knoxia corymbosa, L.
Pavetta tomentosa, Sm.
Gardenia turgida, Roxb
Coffera bengalensis, Roxb.
Hamiltonia suaveolens, Roxb.
Leptodermis lanceolata, Wall.
Spermacoce articularis. L.
Galium asperifolium, Wall.
,, acutum, Edgw.
,, rotundifolium, L.
,, serpylloides, Royle.
,, confertum, Royle.
,, aparine, L
Rubia cordifolia. L.
Asperula cynanchica, L.

Natural Order 65.—*Valerianaceæ.*

Valeriana Wallichii, DC.
,, Hardwickii, Wall.

Natural Order 66 —*Dipsaceæ.*

Morina longifolia, Wall.
,, breviflora, Edgw.
Dipsacus inermis, Wall.

Natural Order 67 —*Compositæ.*

Vernonia anthelmintica, Willd.
,, cinerea, Less.
Elephantopus scaber, L
Adenostemma viscosum, Forst.
,, var. elatum, Don.
,, var. latifolium, Don.
Eupatorium longicaule, Wall.
,, Wallichii, DC.
Solidago Virga-aurea, L.
Cyathocline lyrata, Cass.
Dichrocephala gracilis, DC.
Grangea madraspatana, Poir.
Myriactis nepalensis, Less
,, Wallichii, Less.
Aster alpinus, L.
,, molliusculus, Benth.
,, junceus, Benth.
,, Thomsoni, C B Clarke,
(= Calimeris flexuosa, Royle)
,, peduncularis, Wall.
Erigeron acre, L.
,, bellidioides, Benth.
Conyza veronicæfolia, Wall.

Natural Order 67.—*Compositæ* (contd.)

Conyza absinthifolia, DC.
„ viscidula, Wall.
Blumea lacera, DC.
„ runcinata, DC.
„ hieracifolia, DC.
Sphæranthus hirtus, Willd
Leontopodium alpinum, Cass.
Anaphalis cinnamomea, Benth.
„ triplinervis, Sims.
„ nubigena, DC.
„ nubigena, *var.* polycephala, C. B. Clarke.
„ chionantha, DC.
„ araneosa, DC.
Gnaphalium multiceps, Wall.
„ indicum, L.
Cæsulia axillaris, Roxb.
Inula vestita, Wall
„ nervosa, Wall.
„ barbata, Wall.
„ Cappa, DC.
Carpesium cernuum, L.
„ abrotanoides, L.
Siegesbeckia orientalis, L.
Eclipta erecta, L
Bidens tripartita, L.
Allardia tridactylites, Hf. & T.
Cotula anthemoides, L.
Tanacetum tibeticum, Hf & T.
„ longifolium, Wall.
Artemisia vestita, Wall.
„ vulgaris, L.
Senecio densiflorus, Wall.
„ graciliflorus, DC.
„ laciniosus, Wall.
„ coronopifolius, Desf.
„ alatus, Wall.
„ rufinervis, DC.
„ Kunthianus, Wall.
„ Candolleanus, Wall.
Echinops niveus, Wall.
„ echinatus, Roxb.
Arctium Lappa, Willd.
Saussurea obvallata, Wall.
„ taraxacifolia, Wall.
„ Kunthiana, Wall.
„ depressa, Wall.
„ graminifolia, Wall.
„ Candolleana, Wall.
„ carthamoides, Benth.
„ albescens, Hf. & T.
„ candicans, DC.
„ Roylei, DC.
Jurinea macrocephala, Benth.
Serratula pallida, DC.
Tricholepis elongata, DC.
Leucomeris spectabilis, DC.
Ainslæa pteropoda, DC.
„ aptera, DC.
Gerbera lanuginosa, Benth. et Hf.
Berniera nepalensis, DC.
Tragopogon junceum, Wall.
Youngia lyrata, Cass.

Natural Order 67.—*Compositæ*—(concluded).

Lactuca graciliflora, Wall
„ Brunoniana, Wall.
„ hastata, DC.
„ macrantha, Benth et Hf.
„ longifolia, DC
„ auriculata, DC
„ sagittata, Hf. & T.
„ Tatarica, Benth.
Prenanthes hispidula, DC
Taraxacum Dens-leonis, Desf.
Crepis fœtida, L.
Mulgedium Tataricum, DC.
Microrhynchus sarmentosus, DC.
Gynura nepalensis, DC.
Emilia sonchifolia, DC.
Doronicum Roylei, DC.

Natural Order 68.—*Campanulaceæ.*

Cyananthus integer, Wall.
„ linifolius, Wall.
Wahlenbergia agrestis, A. DC.
Campanula latifolia, L
„ sylvatica, Wall.
„ canescens, Wall.
„ colorata, Wall.
Lobelia trigona, Roxb.
„ pyramidalis, Wall.

Natural Order 69.—*Ericaceæ*

Pernettya repens, Zoll.
Andromeda ovalifolia, Wall.
Rhododendron barbatum, Wall.
„ campanulatum, Don
„ arboreum, Sm.
„ lepidotum, Wall.
„ anthopogon, Don.
Cassiope fastigiata, Don.

Natural Order 70.—*Primulaceæ.*

Primula floribunda, Wall.
„ petiolaris, Wall.
„ purpurea, Royle.
„ rosea, Royle.
„ minutissima, Wall.
„ involucrata, Wall.
„ sibirica, Jacq.
„ denticulata, Wall
Androsace sarmentosa, Wall.
„ Jacquemontii, Duby.
„ rotundifolia, Hardw.
„ incisa, Wall.
„ elegans, Duby.
Lysimachia lobelioides, Wall.
„ pyramidalis, Wall.
„ evalvis, Wall.
„ japonica, Thunb.
Anagallis arvensis, L.
Micropyxis pumila, Duby.
Samolus Valerandi, L.

Natural Order 71.—*Myrsineæ.*

Mæsa indica, A. DC.
„ argentea, Wall.
Embelia robusta, Roxb.
Myrsine semiserrata, Wall.
„ bifaria, Wall.
Ardisia humilis, Vahl.
„ floribunda, Wall.

Natural Order 72.—*Sapotaceæ.*

Bassia butyracea, Roxb.
„ latifolia, Roxb., *at low elevations: planted.*

Natural Order 73.—*Ebenaceæ.*

Diospyros exsculpta, Ham.
„ Melanoxylon, Roxb.
„ montana, Roxb.
„ Embryopteris, Pers.

Natural Order 74.—*Styraceæ.*

Symplocos cratægoides, Ham.
„ spicata, Roxb.
„ racemosa, Roxb.
„ ramosissima, Wall.

Natural Order 75.—*Jasmineæ.*

Jasminum laurifolium, Roxb.
„ pubescens, Willd.
„ punctatum, Wall.
„ arborescens, Roxb.
„ latifolium, Roxb.
„ dispermum, Wall.
„ revolutum, Sims.
„ pubigerum, Don.
„ officinale, L.
„ grandiflorum, L.
„ Zambac, Ait., *cultivated.*
Nyctanthes Arbor-tristis, L.

Natural Order 76.—*Oleaceæ.*

Fraxinus floribunda, Wall.
Ligustrum nepalense, Wall.
„ compactum, Hf. & T.
Olea cuspidata, Wall.
„ glandulifera, Wall.
Chionanthus macrophylla, Wall.
Syringa emodi, Wall.

Natural Order 77.—*Apocyneæ.*

Carissa diffusa, Roxb.
Ophioxylon serpentinum, Willd.
Tabernæmontana coronaria, R. Br.
Vinca pusilla, Murr.
Vallaris dichotoma, Wall.

Natural Order 77.—*Apocyneæ*—(concld).

Wrightia mollissima, Wall.
Holarrhena antidysenterica, Wall.
Alstonia scholaris, R. Br.
Nerium odorum, Solander.
Chonemorpha macrophylla, G. Don.
Ichnocarpus fragrans, Wall.
„ frutescens, R. Br.

Natural Order 78.—*Asclepiadaceæ.*

Cryptolepis elegans, Wall.
Vincetoxicum canescens, Dcne.
„ montanum, Dcne.
Calotropis procera, R. Br.
Dæmia extensa, R. Br.
Periploca calophylla, Falc.
Tylophora carnosa, Wall.
Marsdenia Roylei, Wight.
Pergularia odoratissima, L.
Orthanthera viminea, Wight.
Hoya parasitica, Wall.
Ceropegia longifolia, Wall.
„ lanceolata, Wight.

Natural Order 79.—*Loganiaceæ.*

Gardneria angustifolia, Wall.
Buddleia paniculata, Wall.
„ asiatica, Lour.

Natural Order 80.—*Gentianaceæ.*

Exacum tetragonum, Roxb.
„ pedunculatum, L.
Canscora decussata, R. et S.
„ diffusa, R. Br.
Gentiana tenella, Fries.
„ pedicellata, Wall.
„ argentea, Royle.
„ capitata, Ham.
„ decemfida, Ham.
„ marginata, Griseb.
„ venusta, Wall.
„ depressa, Don.
„ Kurroo, Royle.
Crawfurdia fasciculata, Wall.
Ophelia cordata, Don.
„ lurida, Don.
„ purpurascens, Don.
„ nervosa, Wall.
„ pulchella, Don.
„ angustifolia, Don.
„ Chirayta, Griseb.
Halenia elliptica, Don.
Swertia speciosa, Wall.

Natural Order 81.—*Bignoniaceæ.*

Calosanthes indica, Bl.
Stereospermum chelonoides, DC.
„ suaveolens, DC.

Natural Order 82.—*Pedalineæ.*

Martynia proboscidea, Glox, *naturalized.*
Sesamum indicum, L., Tili, *cultivated.*

Natural Order 83.—*Convolvulaceæ.*

Argyreia speciosa, Sweet.
 „ capitata, Choisy.
 „ setosa, Choisy.
Quamoclit coccinea, Mœnch, } *escaped from gardens.*
 „ vulgaris, Choisy, }
Batatas pentaphylla, Choisy.
Pharbitis Nil, Choisy.
Calonyction speciosum, Choisy.
Ipomœa Pes-tigridis, L.
 „ Turpethum, R. Br.
 „ vitifolia, Sweet.
 „ pilosa, Sweet.
 „ sessiliflora, Choisy.
Convolvulus pluricaulis, Vahl.
Porana paniculata, Roxb.
 „ racemosa, Roxb.
Evolvulus alsinoides, L.
Cuscuta reflexa, Roxb.

Natural Order 84.—*Boraginaceæ.*

Gynaion vestitum, A. DC.
Cordia Rothii, R. et S.
 „ Myxa, L.
 „ latifolia, Roxb.
Ehretia lævis, Roxb.
 „ serrata, Roxb.
Rhabdia viminea, Dalz.
Heliotropium ovalifolium, Vahl.
 „ strigosum, Willd.
Macrotomia Benthami, DC.
Mertensia echioides, Hf. and T.
Myosotis cæspitosa, Schult.
 „ rotundifolia, R. Br.
Eritrichium rotundifolium, DC.
 „ sericeum, Royle.
 „ spathulatum, Royle.
Echinospermum glochidiatum, DC.
Cynoglossum furcatum, Wall.
 „ micranthum, DC.
 „ longiflorum, Benth.
 „ grandiflorum, Royle.
Trichodesma indicum, R. Br.

Natural Order 85.—*Solanaceæ.*

Solanum tuberosum, L., Potato, *introduced.*
Solanum nigrum, L.
 „ verbascifolium, L.
 „ sanctum, L.
 „ xanthocarpum, Schr.
 „ indicum, L.
Physalis minima, L.

Natural Order 85.—*Solanaceæ*—(contd.)

Physalis Peruviana, L., *introduced and almost naturalized.*
Capsicum frutescens, L., Lál-mirch, Chilli, *introduced and naturalized.*
Nicandra physaloides, Gærtn, *naturalized.*
Withania somnifera, Don.
Nicotiana Tabacum, L., Tamáku, *introduced and naturalized.*
Datura Stramonium, L.
 „ fastuosa, L.

Natural Order 86.—*Scrophularineæ.*

Verbascum Thapsus, L.
Celsia coromandeliana, L.
Linaria ramosissima, Wall.
Antirrhinum Orontium, L.
Mimulus nepalensis, Wall.
 „ gracilis, R. Br.
Mazus surculosus, Don.
 „ rugosus, Lour.
Lindenbergia grandiflora, Benth.
 „ urticæfolia, Lehm.
 „ macrostachya, Benth.
Limnophila gratioloides, R. Br.
Herpestis Hamiltoniana, Benth.
 „ Monniera, H. B. K.
Torenia cordifolia, Roxb.
Vandellia crustacea, Benth.
Bonnaya brachiata, Link.
 „ veronicæfolia, Spr.
Hemiphragma heterophyllum, Wall.
Scoparia dulcis, L., *naturalized.*
Veronica Anagallis, L.
 „ Beccabunga, L.
 „ deltigera, Wall.
 „ lanosa, Benth.
 „ alpina, L.
 „ biloba, L.
 „ agrestis, L.
Buchnera hispida, Lamk.
Striga euphrasioides, Benth.
 „ densiflora, Benth.
 „ hirsuta, Benth.
Leptorhabdos parviflora, Benth.
Sopubia trifida, Don.
Euphrasia officinalis, L.
Picrorhiza Kurrooa, Royle.
Pedicularis tubiflora, Fisch.
 „ carnosa, Wall.
 „ pectinata, Wall.
 „ pyramidata, Royle.
 „ gracilis, Wall.
 „ porrecta, Wall.
 „ abrotanifolia, Bieb.
 „ megalantha, Don.

Natural Order 87.—*Lentibulariæ.*

Utricularia flexuosa, Vahl.

Natural Order 88.—*Orobancheæ.*

Phelipæa indica, G. Don.
Ægineta indica, Roxb.

Natural Order 89.—*Gesneraceæ.*

Didymocarpus subalternans, Wall.
" aromaticus, Wall
" macrophyllus, Wall.
" pedicellatus, R. Br.
" lanuginosus, Wall.
Chirita bifolia, Don.
Rhynchoglossum obliquum. Bl.
Platystemma violoides, Wall.
Lysionotus ternifolius, Wall.

Natural Order 90—*Acanthaceæ.*

Thunbergia grandiflora, Roxb.
" coccinea, Wall.
Ebermaiera glauca, N. ab. E.
Hygrophila polysperma, T. Anders.
" spinosa, T. Anders
Petalidium barlerioides, N. ab E.
Hemigraphis Pavala, T. Anders.
Strobilanthes auriculatus, N. ab E.
" glutinosus, T. Anders.
" alatus, N. ab E.
" Wallichii, N. ab E.
" isophyllus, T. Anders
" anisophyllus, T. Anders
Æchmanthera Wallichii, N. ab E.
Dædalacanthus nervosus, T. Anders.
Barleria cristata, L.
Lepidagathis cuspidata, N. ab E.
" purpuricaulis, N. ab E.
" hyalina, N. ab E.
" fasciculata, N. ab E.
Phlogacanthus thyrsiflorus, N. ab E.
Justicia Adhatoda, L.
" peploides, T. Anders.
" procumbens, L.
Rungia pectinata, N. ab E.
" repens, N. ab E.
Dicliptera Roxburghiana, N. ab E.
Peristrophe bicalyculata, N. ab E.
" speciosa,N. ab E.

Natural Order 91.—*Verbenaceæ.*

Verbena officinalis, L.
Lippia nodiflora, Rich.
Lantana alba, Mill.
Premna viburnoides, Wall.
" mucronata, Roxb.
" barbata, Wall.
" herbacea, Roxb.
Callicarpa arborea, Roxb.
" macrophylla, Vahl.
Clerodendron serratum, Spr.
" infortunatum, L.
" Siphonanthus, R. Br.

Natural Order 91.—*Verbenaceæ.* —(concluded).

Caryopteris Wallichiana, Schauer.
Gmelina arborea, Roxb.
Vitex Negundo, L.
Holmskioldia sanguinea, Retz.

Natural Order 92.—*Labiatæ.*

Ocimum canum, L.
" sanctum, L, *naturalized.*
Orthosiphon rubicundus, Benth.
Plectranthus scrophularioides, Wall.
" striatus, Benth.
" Coetsa, Don.
" ternifolius, Don.
" cordifolius, Don.
Coleus barbatus, Benth.
Pogostemon plectranthoides, Desf.
Dysophylla cruciata, Benth.
" pumila, Benth
Colebrookia oppositifolia, Sm.
Elsholtzia polystachya, Benth.
" flava, Benth
" incisa, Benth.
" eriostachya, Benth.
" strobilifera, Benth.
Mentha arvensis, L
" incana, Willd, *var.* Royleana, Benth
Origanum normale, Don.
Melissa calamintha, L
Micromeria biflora, Benth.
Hedeoma nepalensis, Benth.
Salvia glutinosa, L.
" Moorcroftiana, Wall.
" lanata, Roxb.
" plebeja R. Br.
Nepeta spicata, Benth.
" distans, Royle.
" ciliaris, Royle.
" ruderalis, Ham.
" leucophylla, Benth.
" Govaniana. Benth.
Lallemantia Royleana, Benth.
Anisomeles ovata, R. Br
Prunella vulgaris, L.
Scutellaria grossa, Benth.
" repens, Ham.
" linearis, Benth.
" scandens, Don.
Carmotome versicolor, Benth.
Leonurus Royleanus, Benth.
" pubescens, Benth.
" cardiacus. L.
Lamium amplexicaule, L.
" petiolatum, Royle.
Colquhounia coccinea, Wall.
Stachys sericea, Wall.
" splendens, Wall.
Roylea elegans, Wall.
Leucas urticæfolia, R. Br.
" lanata, Benth.
" mollissima, Wall.

Natural Order 92.—*Labiatæ* —(concluded).

Leucas diffusa, Benth.
" hyssopifolia, Benth.
" cephalotes, Spr.
Leonotis nepetæfolia, R. Br.
Phlomis lamiifolia, Royle.
Eremostachys superba, Royle.
Ajuga remota, Benth.
" bracteosa, Wall.
Teucrium Royleanum, Benth.
" quadrifarium, Ham.

Natural Order 93.—*Plantagineæ.*

Plantago major, L.
" Ispaghula, Roxb.

Natural Order 94.—*Chenopodiaceæ.*

Chenopodium album, L.
" Botrys, L.

Natural Order 95.—*Basellaceæ.*

Basella rubra, L. *cultivated and naturalized.*

Natural Order 96.—*Amarantaceæ.*

Deeringia celosioides, Moq.
Rodetia Amherstiana, Moq.
Celosia argentea, Moq.
Amaranthus caudatus, L. *cultivated and naturalized.*
Amaranthus paniculatus, Moq.
" Gangeticus, L.
" frumentaceus, Roxb. Rámdana, Anárdana, *cultivated and naturalized.*
" spinosus, L.
Ærua scandens, Wall.
" lanata, Juss.
Achyranthes aspera, L.
Digera arvensis, Forsk.
Pupalia lappacea, DC.
Cyathula prostrata, Bl.
Alternanthera sessilis, R. Br.

Natural Order 97.—*Nyctagineæ.*

Boerhaavia diffusa, L.
Mirabilis Jalapa, L., *introduced and naturalized.*

Natural Order 98.—*Phytolaccaceæ.*

Pircunia Latbenia, Moq.

Natural Order 99.—*Polygonaceæ.*

Rumex Wallichii, Meissn.
" nepalensis, Spr.
" hastatus, Don.

Natural Order 99.—*Polygonaceæ.* —(concluded).

Rumex vesicarius, L.
Kœnigia Islandica, L.
Rheum emodi, Wall.
" himalense, Royle.
Polygonum Roxburghii, Meissn.
" plebeium, R. Br.
" herniarioides, Del.
" recumbens, Royle.
" aviculare, L.
" barbatum, L.
" amphibium, L.
" lapathifolium, L.
" sphærostachyum, Meissn.
" amplexicaule, Don.
" vaccinifolium, Wall.
" affine, Don.
" nepalense, Meissn.
" sphærocephalum, Don.
" capitatum, Ham.
" chinense, L.
" pterocarpum, Wall.
" rumicifolium, Royle.
Fagopyrum esculentum, Mœnch.
" cymosum, Meissn.
" tataricum, Gaertn.

Natural Order 100.—*Laurineæ.*

Cinnamomum Tamala, N. ab E., *var.* albiflorum, Tejpát.
Phœbe lanceolata, N. ab E.
" pallida, N. ab E.
Machilus odoratissimus, N. ab E.
Tetranthera Roxburghii, N. ab E.
" monopetala, Roxb.
Litsæa consimilis, N. ab E.
" lanuginosa, N. ab E.

Natural Order 101.—*Thymelaceæ.*

Daphne papyracea, Wall.
Wikstrœmia virgata, Meissn.

Natural Order 102.—*Loranthaceæ.*

Loranthus ligustrinus, Wall.
" pulverulentus, Wall.
" vestitus, Wall.
" longiflorus, Desr.
" cordifolius, Wall.
Viscum album, L.
" articulatum, Burm.
" attenuatum, D.C.

Natural Order 103.—*Elæagneæ.*

Hippophaë salicifolia, Don.
Elæagnus umbellata, Thunb.
" latifolia, L.

Natural Order 104.—*Santalaceæ.*

Osyris arborea, Wall.

Natural Order 105.—*Aristolochiaceæ.*

Aristolochia bracteata, Retz.

Natural Order 106.—*Euphorbiaceæ.*

Phyllanthus nepalensis, Müll.
„ parvifolius, Wall.
„ velutinus, Müll.
„ Niruri, L.
„ Emblica, L.
Antidesma diandrum, Tul.
Securinega obovata, Müll.
„ Leucopyrus, Müll.
Putranjiva Roxburghii, Wall.
Andrachne cordifolia, Müll.
Bischoffia javanica, Bl.
Bridelia montana, Willd.
„ stipularis, Bl.
Croton oblongifolius, Roxb., *introduced.*
Trewia nudiflora, Willd.
Mallotus philippinensis, Müll, (Rottlera tinctoria, Roxb).
Ricinus communis, L., *cultivated.*
Homonoya riparia, Lour.
Baliospermum polyandrum, Wight.
Excæcaria insignis, Müll.
Euphorbia indica, Lamk.
„ pilulifera, L.
„ neriifolia, L.
„ Sikkimensis, Boiss.
„ longifolia, Don
„ Helioscopia, L.
„ nepalensis, Boiss.
„ Nivulia, Ham.
„ Royleana, Boiss.
Sarcococca pruniformis, Lindl.

Natural Order 107.—*Cupuliferæ.*

Quercus semecarpifolia, Sm.
„ Ilex, L.
„ dilatata, Lindl.
„ lanuginosa, Don.
„ incana, Roxb.
„ annulata, Sm.

Natural Order 108.—*Myricaceæ*

Myrica sapida, Wall.

Natural Order 109.—*Betulaceæ*

Betula Bhojpattra, Wall.
„ acuminata, Wall.
„ nitida, Don.
Alnus nepalensis, Don.

Natural Order 110.—*Corylaceæ.*

Carpinus viminea, Wall.
„ faginea, Lindl.
Corylus Colurna, Linn.

Natural Order 111.—*Juglandeæ.*

Juglans regia, L.
Engelhardtia Colebrookiana, Lindl.

Natural Order 112.—*Salicineæ.*

Salix tetrasperma, Roxb
„ babylonica, L., *introduced.*
„ elegans, Wall
„ daphnoides, L.
„ flabellaris, Anders.
„ Lindleyana, Wall.
Populus ciliata, Wall.

Natural Order 113.—*Urticaceæ.*

Ulmus integrifolia, Roxb.
„ erosa, Roth.
Celtis caucasica, Willd.
„ australis, L.
Sponia politoria, Planch.
„ orientalis, Planch.
Cannabis sativa, L.
Urtica parviflora, Roxb.
Girardinia heterophylla, Dcne.
Pilea scripta, Wedd.
Lecanthus peduncularis, Wedd.
Elatostemma sessile, Forst.
„ diversifolium, Wedd.
„ Stracheyanum, Wedd.
Bœhmeria rugulosa, Wedd.
„ macrophylla, Don.
„ platyphylla, Don.
Pouzolzia indica, Gaud.
„ viminea, Wedd.
Debregeasia longifolia, Wedd
„ bicolor, Wedd.
Memorialis pentandra, Wedd.
„ hirta, Wedd.
Villebrunea frutescens, Bl.
Maoutia Puya, Wedd.
Cudrania javanensis, Trec.
Streblus asper, Lour.
Morus atropurpurea, Roxb, *introduced.*
„ lævigata, Wall.
„ indica, L.
„ alba, Willd, *cultivated.*
Ficus bengalensis, L., Bar.
„ infectoria, Willd.
„ religiosa, L., Pipal.
„ cordifolia, Roxb.
„ nemoralis, Wall.
„ caudata, Wall.
„ scandens, Roxb.
„ foveolata, Wall.
„ tuberculata, Wall.
„ Roxburghii, Wall.

Natural Order 113.—*Urticaceæ.* —(concluded).

Ficus hispida, L. f.
,, Cunia, Ham
,, glomerata, Willd., Gular.
,, Carica, L. *introduced.*
,, virgata, Roxb.

Natural Order 114.—*Piperaceæ.*

Peperomia reflexa, Dietr.

Natural Order 115.—*Gnetaceæ.*

Ephedra vulgaris, Rich.

Natural Order 116.—*Coniferæ.*

Pinus longifolia, Roxb.
,, Gerardiana, Wall.
,, excelsa, Wall.
Abies Webbiana, Lindl.
,, Smithiana, Forbes.
Cedrus Deodara, Loud.
Cupressus torulosa, Don.
Juniperus communis, L.
,, excelsa, Bieb.
,, recurva, Ham.
Taxus baccata, L.

Natural Order 117.—*Palmaceæ.*

Phœnix acaulis, Roxb.
,, sylvestris, Roxb.
Chamærops Martiana, Wall.
Calamus Royleanus, Griff.
Wallichia densiflora, Mart.

Natural Order 118.—*Aroideæ.*

Arisæma Jacquemontii, Bl.
,, utile, Hf. & T.
,, costatum, Mart
,, speciosum, Mart.
,, curvatum, Kunth.
Sauromatum guttatum, Schott
Remusatia vivipara, Schott.
Amorphophallus campanulatus, Bl.
Colocasia, species.
Scindapsus officinalis, Schott
,, decursiva, Schott.
Typhonium, species.
Pothos scandens, L.
Acorus calamus, L.

Natural Order 119.—*Lemnaceæ*

Lemna minor, L.
,, polyrhiza, L.

Natural Order 120.—*Typaceæ.*

Typha elephantina, Roxb.

Natural Order 121.—*Juncaginaceæ.*

Potamogeton pectinatus, L.
Aponogeton monostachyus, Roxb.

Natural Order 122.—*Scitamineæ.*

Globba Orixensis, Roxb.
Zingiber capitatum, Roxb.
,, Cassumunar, Roxb.
,, ligulatum, Roxb.
Curcuma angustifolia, Roxb.
,, Zerumbet, Roxb.
Roscoea elata, Sm.
,, alpina, Roxb.
,, spicata, Sm
,, purpurea, Sm.
Amomum subulatum, Roxb.
Hedychium coronarium, L., *in gardens.*
,, spicatum, Sm.
,, coccineum, Ham.
Costus speciosus, L.
Musa paradisiaca, L. plantain, *cultivated.*
,, nepalensis, Wall.

Natural Order 123—*Orchidaceæ.*

Oberonia iridifolia, Lindl.
Dienia cylindrostachya, L.
Liparis obcordata, Vahl.
Cœlogyne cristata, Lindl.
,, ocellata, Lindl.
,, ovalis, Lindl.
Eria convallarioides, Lindl.
,, alba, Lindl
,, flava, Lindl.
Dendrobium erneflorum, Griff.
,, alpestre, Royle
Otochilus, species.
Apaturia Smithiana, Lindl.
Eulophia, campestris, L.
,, herbacea, Lindl.
Cyrtopera fusca, Wight.
Vanda cristata, Lindl.
Saccolabium guttatum, Lindl.
,, Gharwalicum, Reichb. f.
Aerides affine, Wall.
,, odoratum, Lowe.
,, Hystrix, Lindl.
,, difforme, Wall.
Calanthe puberula, Lindl.
Orchis latifolia, L.
Gymnadenia cucullata, Rich.
,, spathulata, Lindl.
Aceras angustifolia, Lindl.
Platanthera orchidis, Lindl.
,, clavigera, Lindl.
,, obcordata, Lindl.
,, Susannæ, Lindl
,, candida, Lindl
,, acuminata, Lindl.

Natural Order 123.—*Orchidaceæ* —(concluded).

Gamoplexis orobanchoides, Falc.
Epipactis latifolia, Sw.
" macrostachya, Lindl.
Spiranthes australis, R. Br.
Habenaria pectinata, Lindl.
" intermedia, Don.
" marginata, Lindl.
" longifolia, Lindl.
Peristylus Goodyeroides Lindl.
Herminium Monorchis, Sw.
" species.
Satyrium nepalense, Don.
Monochilus flavus, Wall.
Tripleura pallida, Lindl.
Goodyera marginata, Lindl.
Cypripedium cordigerum, Don.

Natural Order 124.—*Iridaceæ*.

Iris sulcata, Wall.
" decora, Wall.
" Kumaonensis, Wall.
" nepalensis, Wall.

Natural Order 125—.*Amaryllidaceæ*.

Crinum toxicarium, Roxb.
" amoenum, Roxb.
Curculigo recurvata, Roxb.
Hypoxis aurea, Lour.
" orchioides, Kz.

Natural Order 126.—*Dioscoreæ*.

Dioscorea deltoidea, Wall.
" sagittata, Royle.
" pentaphylla, L.

Natural Order 127.—*Liliaceæ*.

Tulipa stellata, Hook.
Gagea thesioides, Fisch.
" elegans, Wall.
Iphigenia indica, Kth.
Lloydia serotina, Reichb.
Fritillaria cirrhosa, Don.
" verticillata, Royle.
Lilium giganteum, Wall.
" Wallichianum, R. et S.
" nepalense, Wall.
" Thomsonianum, Hf.
" roseum, L.
Gloriosa superba, L.
Allium Victoriale, L.
" Wallichii, Kth.
" tuberosum, Roxb.
" Govanianum, Wall.
" consanguineum, Kth.
" rubens, Schrad.

Natural Order 127.—*Liliaceæ* —(concld.)

Urginea indica, Kunth.
Asphodelus clavatus, Roxb.
Asparagus racemosus, Willd.
" filicinus, Ham.
Polygonatum multiflorum, All
" sibiricum, Red.
" verticillatum, All.
Flüggea intermedia, Sch.
" Wallichiana, Kth.
Smilax maculata, Roxb.
" elegans, Wall.
" macrophylla, Roxb.
" ovalifolia, Roxb.
Paris polyphylla, Sm.
Trillidium Govanianum, Kth.
Disporum Pitsutum, Don.
" calcaratum, Don.

Natural Order 128.—*Alismaceæ*.

Alisma Plantago, L.
" reniforme, Don.
Sagittaria sagittifolia, L.

Natural Order 129.—*Pontederaceæ*.

Monochoria hastata, Presl.

Natural Order 130.—*Commelynaceæ*.

Cyanotis axillaris, R. et S.
" barbata Don.
Commelyna salicifolia, Roxb.
" bengalensis, L.
" obliqua, Ham.
Aneilema herbaceum, Wall.

Natural Order 131.—*Juncaceæ*.

Juncus concinnus, Don.
" leucomelas, Royle.
" castaneus, L.
" bufonius, L.
" effusus, L.
" leucanthus, Don.

Natural Order 132.—*Restiaceæ*.

Eriocaulon quinquangulare, L.
" trilobum, Ham.
" sexangulare, L.

Natural Order 133.—*Cyperaceæ*.

Carex rigida, Good.
" Thomsoni, Boot.
" mitis, Boot.
" nubigena, Don.
" foliosa, Don.

Natural Order 133.—*Cyperaceæ*—(concluded.)

Carex longipes, Don
„ Moorcroftii, Falc.
„ alopecuroides, Don.
„ Wallichiana, Presc.
„ setigera, Don.
„ cruenta, Nees.
„ uncinoides, Boot.
„ vesiculosa, Boot.
„ filicina, Nees.
„ condensata, Nees.
„ bengalensis, Roxb.
Rhynchospora aurea, Nees.
„ Wallichiana, Nees.
Fimbristylis quinquangularis, Nees.
„ dichotoma, Vahl.
„ æstivalis, Vahl
„ complanata, Link.
Scirpus juncoides, Roxb.
„ affinis, Roth.
„ mucronatus, L.
Abilgaárdia monostachya, Vahl.
Eleocharis uniglumis, R. Br.
„ palustris, R. Br.
„ ovata, R. Br.
Isolepis setacea, R. Br.
„ trifida, Nees
„ supina, R. Br.
„ Roylei, Nees.
Kyllingia monocephala, L.
„ brevifolia, Rottb.
„ triceps, Nees.
Eriophorum comosum, Wall.
Cyperus pygmæus, Vahl.
„ alopecuroides, Rottb.
„ compressus, L.
„ niveus, Retz.
„ difformis, L.
„ Iria, L.
„ rotundus, L.
Mariscus paniceus, Vahl.

Natural Order 134.—*Gramineæ.*

Oryza sativa, L., Rice, *cultivated.*
Zea Mays, L., Makai, Bhuta, Indian Corn, *introduced and cultivated.*
Coix Lachryma, L.
„ gigantea, Koen
Milium effusum, L., *introduced.*
Paspalum pedicellatum, Nees
„ scrobiculatum, L. *cultivated.*
„ Royleanum, Nees.
Coridochloa semialata, Nees.
Panicum sanguinale, L.
„ ciliare, Retz.
„ miliaceum, L., *cultivated.*
„ maximum, Jacq.
„ ovalifolium, Poir.
„ longipes, W. & A.
„ miliare, Lamk.
„ vestitum, Nees.
„ plicatum, Roxb.

Natural Order 134. *Gramineæ* (contd.)

Panicum prostratum, Lamk.
„ repens, L.
Oplismenus colonus, Kth
„ compositus, R. & S
„ frumentaceus, Kunth, *cultivated.*
„ stagninus, Kth.
Setaria glauca, Beauv.
„ italica, Kth., *naturalized; cultivated.*
„ verticillata, Beauv.
Penicillaria spicata, Lamk, Bajra, *cultivated.*
Pennisetum cenchroides, Rich.
„ triflorum, Nees
Gymnothrix flaccida, Munro
Arundinella setosa, Trin.
Sporobolus diandrus, Beauv.
„ elongatus, R. Br.
Agrostis alba, L
„ ciliata, Trin.
Mühlenbergia sylvatica, Trin.
„ geniculata, Nees.
„ viridissima, Nees.
Polypogon littoralis, L.
Calamagrostis Epigejos, Roth.
Orthoraphium Roylei, Nees.
Piptatherum æquiglume, Munro.
Alopecurus pratesis, L.
Phleum arenarium, L.
Phragmites Roxburghii, Kunth.
Chloris barbata, Swartz.
Eleusine indica Gærtn
„ Coracana, Gærtn, *cultivated.*
„ verticillata, Roxb.
Cynodon Dactylon, Pers, Dub.
Avena fatua, L.
„ pratensis, L.
Poa *annua*, L.
„ pratensis, L.
„ bulbosa, L
Eragrostis plumosa, Link.
„ pilosa, L.
„ verticillata, Beauv.
„ unioloides, Nees.
„ poæoides, Beauv.
„ nardoides Trin.
„ diandra, Roxb.
Melica ciliata, L
Kœleria cristata, Pers.
„ phleoides, Pers.
Dactylis glomerata, L.
Festuca duriuscula, L.
Bromus squarrosus, L.
„ arvensis, L.
„ giganteus, L.
Arundinaria falcata, Nees.
„ Falconeri, Kz.
Thamnocalamus spathiflorus, Munro,
Bambusa arundinacea, L
Dendrocalamus strictus, Nees.
Hordeum hexastichon L., Jau, Barley, *cultivated.*

Natural Order 131.—*Gramineæ*—(concld.)

Hordeum vulgare, L., *cultivated.*
Elymus sibiricus, L.
Lolium speciosum, Stev.
" temulentum, L
Triticum vulgare, Vil., Gehún, Wheat, *cultivated*
Mnesithea lævis, Kth.
Rottboellia exaltata, L.
Ophiurus corymbosus, Grtn.
Manisuris granularis, Sw.
Andropogon Gryllus, L.
" acicularis, Retz.
" involutus, Steud.
" montanus, Roxb.
" Ischæmum, L
Heteropogon contortus, R. & S
" Roylei, Nees
Sorghum vulgare, Pers., Joar, *cultivated.*
" Halepense, L.
Apocopis Royleanus, Nees
Batratherum molle, Nees.
" lancifolium, Trin.
" echinatum, Nees.
Anatherum muricatum, Beauv.
Cymbopogon laniger, Desf
" flexuosus, Nees
" Martini, Munro
" Schœnanthus, L.
" Nardus, L.
Androscepia gigantea, Brongn
Anthistiria arundinacea, Nees.
" Anathera, Nees
" scandens, Roxb.
Apluda aristata, L.
" geniculata, Roxb
Imperata arundinacea, Cyrill.
Saccharum spontaneum, L.
" procerum, Roxb
" officinarum, L., Sugarcane *cultivated, introduced.*
" Sara, Roxb.
" filifolium, Nees.
Erianthus Ravennæ, Beauv.
" japonicus, Beauv.

CRYPTOGAMS.

Filices or Ferns.

Woodsia elongata, Hk.
" lanosa, Hk
Dicksonia appendiculata, Wall.
" scabra, Wall
Davallia pulchra, Don.
" divaricata, Bl.
" immersa, Wall.
" nodosa, Hk.
Adiantum lunulatum, Burm.
" caudatum, L.
" Capillus-Veneris, L.

Filices or Ferns—(continued.)

Adiantum venustum, Don
Cheilanthes Dalhousiæ, Hk
" farinosa, Kaulf.
Onychium auratum, Kaulf.
" japonicum, Kunze.
Pellea, calomelanos, Link.
Pteris longifolia, L.
" cretica, L.
" quadriaurita, Retz.
" aquilina, L.
" Wallichiana, Agdh
Woodwardia radicans, Sm.
Asplenium, alternans, Wall.
" varians Hk. and Gr.
" viride, Huds.
" Trichomanes, L
" planicaule, Wall.
" fontanum, Bernh.
" bulbiferum, Forst.
" tenuifolium, Don.
" Filix fœmina, Bernh.
" polypodioides, Mett.
" dilatatum, Wall
" esculentum, Presl
" Ceterach, L.
" australe, Brack.
Aspidium auriculatum, Sw.
" aculeatum, Sw
" Thomsoni, Hk.
" aristatum, Sw.
" falcatum, Sw.
Nephrodium unitum, R. Br
" prolixum, Bak.
" sparsum, Don.
" molle, Desv.
" cicutarium, Bak.
" polymorphum, Bak
" Filix-mas, Rich.
" cochleatum, Don.
" odoratum, Bak.
Oleandra Wallichii, Hk.
" neriiformis, Cav.
Polypodium erubescens, Wall.
" proliferum, Presl.
" lineatum, Colebr.
" amœnum, Wall.
" lachnopus, Wall.
" malacodon, Hk
" trifidum, Don.
" Lingua, Sw.
" stigmosum, Sw
" fissum, Bak.
" flocculosum, Don.
" lineare, Thunb.
" normale, Don
" membranaceum, Don.
" propinquum, Wall.
" juglandifolium, Don.
" quercifolium, L.
" himalense, Hook.
" leiorhizon, Wall.
Acrostichum virens, Wall
Gymnogramme vestita, Hk.

Filices or Ferns—(concld.)

Gymnogramme Andersoni, Bedd.
" javanica, Bl.
" lanceolata, Hk.
" involuta, Don.
Osmunda Claytoniana, L.
Schizaea digitata, Sw.
Lygodium, scandens, Sw.
" japonicum, Sw
Botrychium daucifolium, Wall
" Lunaria, Sw.
" Virginianum, Sw.

Lycopodiaceæ.

Selaginella Jacquemontii, Spring.
" setacea, Spring
" subulifolia, Spring.

Marsileaceæ

Marsilea qudrifolia, L

Characeæ

Chara verticillata, Roxb.

PLANTS OF KUMAON.[1]

Area under notice.

The following list gives the names of all plants known to have been found in Kumaon, Garhwál and the Bhábar, three of the districts which are included in the Commissionership of Kumaon. Plants of the plains of India, plants growing in Tibet, and plants only found in the Independent States of Nepál and Tihri, do not appear in this list. The words, "common," "frequent," and "rare" have been employed to denote the comparative occurrence of the various species; but as the European stations of Almora, Naini Tál, and Ránikhet are all situated at a height of between 5,000 and 7,000 feet above the level of the sea, it will be easily understood that plants growing about that level are more likely to meet an observer's eye than plants which grow either at a very high, or at a very low elevation. Plants which are marked "rare" without any locality being given, are those which have been found by former observers, but which have never been seen growing within the limits of the division by Colonel Davidson, Mr. Waterfield or Dr. Watson. In the arrangement of the orders, genera, and species, Hooker's 'Flora of British India,' has been followed as far as published, that is to say, to the end of *Polypetalæ*. With regard to the other groups the books chiefly consulted have been *Brandis' Forest Flora*, Madden's Papers in the Journal of the Asiatic Society, Royle's Illustrations of Himalayan Botany, C. B. Clarke's Compositæ and Commelynaceæ, Steudel's Grasses, and Cyperaceæ, Hooker and Baker's Ferns, Mitten's Mosses.

Range of plants.

Synonyms have rarely been given except where the name adopted in the list is different from that given by Royle. Royle's Illustrations, published in 1839, is still a standard work on Himálayan Botany, and most of the plants figured in it are found in the Commissionership of Kumaon. There are, however, in Royle's book a certain number of plants which are common near Mussooree, where the book was written, but which are not found east of the Alaknanda river, the boundary between the Kumaon Commissionership and the Native State of Tihri. As examples of these Mussooree plants not found in Kumaon may be quoted—

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[1] This notice and list has been prepared for this volume by Mr. W. Watson, M.D., Deputy Sanitary Commissioner, Almora.

Dictamnus albus, Berberis Lycium, Rosa Lyelli, Sonerila tenera, Gentiana Kurroo, Picrorhiza Kurroo, Eremostachys superba.

On the other hand, the common *phalel* tree of Eastern Kumaon (*Bassia butyracea*) is apparently not found at Mussooree, as it is not mentioned by Royle as occurring there. The same remark applies to the very common and very beautiful *Silang* tree of Kumaon (*Olea acuminata*). This tree, conspicuous from its sweet scented yellow blossoms, is never alluded to by Royle, so that he probably never met with it near Mussooree. It is found in Kumaon at all elevations from 3,000 to 7,000 feet. There are fine trees of it at Debi Dhúra at a height of 6,800 feet, and at Kapkot at a height of 3,400 feet.

Eastern depression.

The Kumaon Division includes a tract of country varying much in elevation. On the south, the Bhábar strip along the foot of the hills has a mean height of about 1,400 feet, whilst the passes that lead into Tibet have an elevation exceeding 18,000 feet. It might be expected that European forms would be more abundant towards these passes than in the Bhábar, and this, on the whole, is the case. There are, however, some European plants that are only found at low elevations and are never seen above 6,000 feet. The most common of these are:—*Ranunculus sceleratus, Geranium molle, Veronica Anagallis,* and *Verbena officinalis,* and it is difficult to assign an adequate reason for this phenomenon. Another remarkable fact connected with the montane flora is the eastern depression of many Himálayan plants. By this term is understood that plants which occur only at high elevations near Simla are found to grow at lower elevations at Mussooree and at still lower heights near Naini Tál. The following plants may be named as affording examples of eastern depression—

(*a*) The shrub *Coriaria nepalensis,* which gives its name to the station of Mussooree, is said by Royle not to grow under 5,000 feet at Mussooree. In Kumaon, however, it descends as low as 2,000 feet.

(*b*) *Hemiphragma heterophylla*, one of the *Scrophulariaceæ*, is never found at Simla below 10,000 feet, whilst it occurs in Kumaon at 7,000 feet, and is common there at 8,000 feet.

(*c*) The *Tilonj* oak, *Quercus dilatata*, is found at Simla about 7,000 feet, and near Naini Tál it grows abundantly down to 3,000 feet.

(*d*) *Dipsacus inermis* is one of the most common plants at Almora (5,500 feet), but is not found towards Simla at elevations below 8,000 feet.

(*e*) *Elsholtzia polystachya*, another common Almora plant, is found in Kumaon as low down as 4,000 feet, but near Simla it is not met with under 7,000 feet.

(*f*) *Senecio densiflorus* and *S. rufinervis*, with auricled leaves, are common all over Kumaon in November as low as 4,000 feet, but are not found in the neighbourhood of Simla under 7,000 feet.

It does not follow, and is not apparently true, that the higher limit of these plants follows the same law as their lower limit, but of the existence of the law of eastern depression of the lower limit of Himálayan plants, there can be little doubt. There is no example, so far as is known, of the converse, that is to say, of a plant confined to the higher ranges in Kumaon and growing at a low level near Simla.

With regard to certain plants being confined to particular rock formations, some interesting observations were made by Major Madden; thus he found that *Trigonella gracilis*, *Argyrolobium roseum*, and *Argyrolobium flaccidum* were confined to limestone rock. *Thymus serpyllum*, on the contrary, is only found on micaceous rock formations.

Introduced plants.

One of the most interesting facts for investigation in the Flora of any country is the number of introduced plants which have become wild. Of these, two may be noticed in Kumaon. The *deodár* tree, which is really a native of the Himálaya west of the Alaknanda, but being a sacred tree, it has for many generations been planted round almost every Kumaon temple. There are now magnificent groves at Gangolihát, Lohaghát, Champháwat, and Bála Jageswar, and there is a tree at Wán in Garhwál which is certainly many hundreds of years old. Still the *deodár* is undoubtedly not indigenous. The other plant is a weed and is of comparatively recent introduction. It is the *Erigeron canadense*, known to the natives as the locust weed, *(sallo)* because it is believed to spring from soil where locusts have alighted. This plant is not mentioned by Major Madden, who published his papers in the year 1840, and it has therefore in all probability made its appearance since that date. It is now a most common and a most troublesome weed in cultivated fields.

Indigenous drugs.

Many of the Kumaon plants are collected by the villagers and sold to herbalists to be used in medecine. The chief marts are Haldwáni, Barmdeo, and Ramnagar in Kumaon, and Kotdwára in Garhwál. The articles most in demand are the fruit of *Terminalia Chebula*, the roots of *Curcuma longa*, *Kyllingia triceps*, *Piper silvaticum*, and the various species of aconite; the bark of *Myrica sapida* and *Cinnamomum Tamala*; the rind of the fruit of the pomegranate; the powder from *Mallotus philippinensis*, and the various species of *chiretta*, all of which will be noticed hereafter in the chapter on 'Economic Botany.'

Dr. Watson desires to record and acknowledge the assistance that he has received in the preparation of this list from his friends Dr. King, Director of the Royal Botanical Gardens, Calcutta; Colonel Davidson, R.E., and Mr. W. Waterfield of the Bengal Civil Service.

PLANTS OF KUMAON.

DIVISION I.—POLYPETALÆ.

No.	Scientific name.	Vernacular name.	Note.
	ORDER 1.—RANUNCULACEÆ.		
1	Clematis (Cheiropsis) Nepaulensis ..	...	December, near streams, rare.
2	" " montana ...	Ghantiáli ...	April, common.
3	" " barbellata ...	.	May; rare
4	" (Flammula) grata ...	Ghantiáli ..	Common
5	" " Gouriana .	..	Bhábar and valleys; October
6	" " puberula .	...	Colonel Davidson
7	" " orientalis [parvifolia Edgeworth.]	..	Above 10,000 feet
8	" " nutans .	..	May. Common.
9	" " acuminata .	.	Rare
10	" " connata [amplexicaulis velutina and gracilis, Edgeworth.]	Ghantiáli ...	August, September. Very common
11	" " Buchananiana,	Ghantiáli ..	October Very common
12	" " grewiæflora	..	Rare.
13	Anemone (Eriocephalus) vitifolia ...	...	June and July; common.
14	" (Anemonanthea) obtusiloba,	Kakriya ..	May. Very common.
	" [Govaniana and discolor] .	..	Above 6,000 feet.
15	" " rupestris ..	...	June Above 10,000 feet.
16	" " rivularis ..	...	Common
17	" (Omalocarpus) polyanthes,	...	Rare, 10,000 feet.
18	" " elongata ...	...	" "
19	Thalictrum (Physocarpum) elegans ...	...	" "
20	" " platycarpum ...	...	Rare. Badrináth ✓
21	" " cultratum ...	...	Rare.
22	" " Chelidonii ..	...	"
23	" " reniforme [neurocarpum, Royle.]	...	Common; high elevations, July.
24	" " pauciflorum ...	...	Frequent.
25	" (Euthalictrum) Punduanum,	.	Common.
26	" " saniculæforme,	...	On trees; autumn.
27	" " Javanicum	.	"
28	" " foliolosum ..	Penglá jarí...	Very common, summer.
29	" " minus ...	" ...	Frequent.
30	Callianthemum cachemirianum ...	...	Above 10,000 feet.
31	Adonis æstivalis	...	" "
32	Ranunculus (Batrachium) aquatilis...	.	Bhím Tál.
33	" (Hecatonia) sceleratus ..	Shím ...	Common up to 4,000 feet
34	" " hirtellus ..	...	High elevations.
35	" " diffusus ...	...	Common
36	" " lætus ...	Dainiya ...	Very common.
37	" (Echinella) flaccidus ...	.	Rare.
38	" " arvensis ...	Ainwa ...	Common at low levels.

DIVISION I.—POLYPETALÆ—(*continued*).

No.	Scientific name.	Vernacular name.	Note.
	ORDER 1.—RANUNCULACEÆ—(concluded)		
39	Oxygraphis glacialis	...	Above 15,000 feet.
40	,, polypetala	...	,, 10,000 ,,
41	Caltha palustris [Govaniana, Royle],	...	Common.
42	Trollius acaulis	...	Above 10,000 feet.
43	,, pumilis	...	,, 12,000 ,,
44	Isopyrum grandiflorum	...	,, ,, ,,
45	Aquilegia vulgaris		Common.
46	Delphinium denudatum [pauciflorum, Royle.]	Múnila ...	,,
47	,, cæruleum	...	Above 15,000 feet.
48	,, elatum	...	China hill 8,000 feet.
49	,, vestitum	.	,, 8,000 ,,
50	,, Cashmirianum	.	,, 10,000 ,,
51	,, Ajacis	Múnila ...	Naturalized
52	Aconitum Lycoctonum	Bish ...	Above 8,000 feet
53	,, palmatum	..	,, ,, ,,
54	,, ferox	..	,, 10,000 ,,
55	,, Napellus	.	,, ,, ,,
56	,, heterophyllum	Atis ...	,, 8,000 ,,
57	Actæa spicata	...	Rare.
58	Cimicifuga fœtida		,,
59	Pæonia emodi	Bhúnya madín,	Young shoots eaten
	ORDER 2.—DILLENIACEÆ.		
1	Dillenia indica	...	Rare.
	ORDER 3.—MAGNOLIACEÆ		
1	Michelia Kisopa	Ban champa,	Common; Beripul and Ukhimath.
2	Schizandra grandiflora	Silangti .	Frequent; Gágar.
3	,, propinqua	Sindháyan .	Common
	ORDER 4.—ANONACEÆ.		
1	Polyalthia Korinti [Guatteria Korinti, Madden.]	...	Swamps. Bhábar.
2	Anona squamosa	Boha ..	Ditto ,,
3	Miliusa velutina	.	Rare.
4	Saccopetalum tomentosum	Kangri ..	Kotdwára
	ORDER 5.—MENISPERMACEÆ.		
1	Tinospora cordifolia	Gurcha .	Common
2	Cocculus laurifolius	Tilbara panyáli and kakra.	,, about 4,000 feet
3	,, villosus	.	Rare.
4	Stephania elegans	..	,,
5	,, rotunda [Roxburghiana]	Ganjára ..	Common.
6	Cissampelos Pareira [convolvulacea],	Pári ...	,,

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name.	Vernacular name	Note.
	ORDER 6.—BERBERIDEÆ		
1	Holbœllia latifolia	Gophla	May, common, Ránikhet and Binsar.
..	„ *var.* angustifolia	...	
2	Berberis (Mahonia) nepalensis	Gophla	Frequent, Thákil and Binsar.
3	„ (Euberberis) vulgaris		High elevations.
4	„ „ umbellata		Rare
5	„ „ aristata	Chotra	Common High elevations
6	„ „ Lycium		Rare
7	„ „ asiatica	Kilmora	Common.
8	„ „ Wallichiana		China hill, Colonel Davidson.
9	Podophyllum emodi		High elevations.
	ORDER 7. NYMPHACEÆ.		
1	Nelumbium speciosum	Kanwál	Frequent, Buwáli pokar.
	ORDER 8 PAPAVERACEÆ		
1	Papaver dubium [glabrum, Royle]	Tákuvia	Common.
2	Argemone mexicana	Bhar bhánd,	Bhábar; introduced.
3	Meconopsis aculeata	Kánda	Above 10,000 feet
4	„ robusta	„	„ „ „
5	„ nipalensis	„	„ „ „
6	Stylophorum lactucoides	...	...
	ORDER 9 FUMARIACEÆ.		
1	Dicentra Roylei	..	Rare
2	„ scandens	..	Common.
3	Corydalis rutaefolia [diphylla]	..	„
4	„ cachemiriana		Above 9,000 feet.
5	„ crithmifolia		Rare.
6	„ elegans	...	Above 10,000 feet.
7	„ Govaniana	..	„ 8,000 „
8	„ ramosa	..	„ 12,000 „
9	„ sibirica [filiformis]	..	Common.
10	„ cornuta	Bhutkes	Very common,
11	„ chaerophylla	...	Common, Binsar.
12	„ meifolia	...	Above 10,000 feet.
13	„ flabellata		„ 9,000 „
14	Fumaria parviflora [Vaillantii]	Khairuwa	Very common
	ORDER 10. CRUCIFERÆ		
	TRIB. ARABIDEÆ.		
1	Nasturtium officinale	Piriyá hálim,	Cultivated.
2	„ palustre	...	Common.
3	„ montanum	..	„
4	Barbarea vulgaris	..	„
5	Arabis glabra	...	Frequent.

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name	Vernacular name.	Note
	ORDER 10. CRUCIFERÆ—(continued).		
	TRIBE ARABIDEÆ—(concluded)		
6	Arabis alpina	...	Frequent
7	„ amplexicaulis	Rái ghás	Common
8	Cardamine hirsuta		..
9	„ impatiens	Sheliya	Very common
10	„ macrophylla	...	Common
	TRIBE ALYSSINEÆ		
11	Alyssum maritimum	...	Naturalized.
12	„ canescens	..	Above 14,000 feet
13	Draba (Chrysodraba) alpina	...	„ 12,000 „
14	„ (Leucodraba) incana	.	„ 10,000 „
15	„ „ lasiophylla	.	„ 12,000 „
16	„ „ fladnizensis	..	„ 13,000 „
	TRIBE SISYMBRIEÆ		
17	Sisymbrium mollissimum	...	Above 8,000 feet
18	„ himalaicum	...	„ 10,000 „
19	„ Thalianum	.	Common
20	„ rupestre	...	Above 8,000 feet
21	„ strictum	...	Common.
22	„ Wallichii	...	„
23	„ sophia	Jauá ghás	„
24	„ Columnæ	...	Frequent.
25	„ Alliaria	...	Rare.
26	Eutrema primulæfolium	...	„
27	Erysimum hieracifolium	...	„
	TRIBE BRASSICEÆ.		
28	Brassica nigra	Káli sarson	Cultivated.
29	„ campestris	...	„
	„ *var. dichotoma*	*Jariya*	„
	„ *var.* glauca, Rox	Rara, píla sarson	„
	„ *var.* glauca, Royle	Dain toriya	„ up to 11,000 feet.
30	„ trilocularis		Weed in fields
31	„ juncea	Rái	Cultivated.
32	Eruca sativa	Dáá	Common.
	TRIBE LEPIDINEÆ		
33	Capsella Bursa-pastoris	..	Very common
34	Lepidium sativum	Hálim	Common.
35	„ capitatum	..	Above 10,000 feet.
36	„ ruderale	...	Common, May and June, Almora.
	TRIBE THLASPIDEÆ.		
37	Megacarpæa polyandra	.	Above 10,000 feet.
38	Thlaspi arvense	Dhapriya	Common.
39	„ alpestre	.	Above 7,000 feet.
40	Iberidella Andersoni	...	„ 12,000 „

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name	Vernacular name.	Note.
	ORDER 10. CRUCIFERÆ—(concluded).		
	TRIBE RAPHANEÆ.		
41	Raphanus sativus	Múli ..	Cultivated
	ORDER 11.—CAPPARIDACEÆ.		
1	Cleome [Polanisia, Madden] viscosa ..	..	Common, Bhábar and valleys
2	Gynandropsis pentaphylla .	..	Bhábar and valleys
3	Capparis spinosa [*var.* leucophylla] .	Ulta kánta ...	Common
4	" horrida	" ...	Bhabar
5	Maerua arenaria [Niebuhria oblongifolia, Royle, Ill.]	...	Rare.
	ORDER 12.—RESEDACEÆ.		
1	Reseda odorata . ..	...	Naturalized.
	ORDER 13.—VIOLACEÆ.		
1	Viola biflora [reniformis] ...	.	Common.
2	" Patrinii [cæspitosa] ...	..	"
3	" diffusa . .		Rare.
4	" serpens [canescens, Wall.] .	...	Common
5	" kunawarensis .. .	..	Above 11,000 feet
	ORDER 14.—BIXINEÆ.		
1	Cochlospermum Gossypium ..	Kumbi, katira,	Common, Bhábar.
2	Flacourtia Ramontchi	Kandai ...	"
3	" sepiaria	" ...	"
4	Xylosma longifolium	Katái ...	Rare.
	ORDER 15.—PITTOSPORACEÆ.		
1	Pittosporum floribundum .	...	Common, river banks.
2	" eriocarpum	Gar siling ...	"
	ORDER 16.—POLYGALACEÆ.		
1	Polygala triphylla [glaucescens, Wall.],	..	Common, autumn.
2	" crotalarioides	...	Very common.
3	" abyssinica ..	..	Rare.
4	" leptalea [oligophylla, Wallich]	...	Common up to 4,000 feet.
5	" persicariæfolia ...	...	August, frequent
6	" chinensis, [Rothiana, W. and A.]	...	Common, Bhábar,
7	" sibirica [elegans, Wallich],	...	"
	ORDER 17.—CARYOPHYLLACEÆ.		
	TRIBE SILENEÆ.		
1	Gypsophila cerastioides	...	Common about 10,000 feet.
2	Saponaria vaccaria	...	Introduced.
3	Silene inflata	...	Common.

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name.	Vernacular name.	Note.
	ORDER 17.—CARYOPHYLLACEÆ—(concluded).		
	TRIBE SILENEÆ—(concluded).		
4	Silene conoidea	..	Common
5	„ gallica	..	Introduced.
6	„ Falconeriana	...	Common.
7	„ Stracheyi	.	Rare
8	Cucubalus bacciferus	..	„
9	Lychnis multicaulis . ..	...	„
10	„ inflata, Blinkworth ...	..	Very rare
11	„ indica [fimbriata, Madden],	...	Very common.
	TRIBE ALSINEÆ.		
12	Cerastium dahuricum ..	...	Rare.
13	„ vulgatum [triviale, Madden]	...	Very common
14	„ Thomsoni .. .	..	Rare
15	Stellaria (Schizostegium) crispata [monosperma, Don]	..	Common
16	„ „ paniculata [media, Wight	...	Rare
17	„ (Malachium) aquatica ...	...	„
18	„ (Eustellaria) media [monogyna, Don].	..	„
19	„ „ semivestita ...	..	Painkhanda; common
20	„ „ Webbiana, [Leucostemma angustifolia, Wall]	..	Very common
21	„ „ latifolia, [leucostemma latifolia, Wall]	...	Rare. Hándpáni.
22	„ (Larbrea) longissima [patens, Don]	...	„
23	„ (Adenonema) decumbens ..	...	Above 11,000 feet
24	Arenaria (Alsine) foliosa .	...	Painkhanda; common, June
25	„ (Eremogone) festucoides ..	...	Rare
26	„ (Euthalia) serpyllifolia .	.	Common, May & June.
27	„ „ orbiculata .	..	„
28	„ (Lepyrodiclis) holosteoides,	.	„
29	„ Benthami ..	...	Rare.
30	Spergula arvensis ...		Introduced
31	„ pentandra [Arenaria flaccida, Roxb.]	...	„
	TRIBE POLYCARPEÆ.		
32	Drymaria cordata . .	...	Common
33	Polycarpæa corymbosa .	...	„
	ORDER 18.—PORTULACEÆ.		
1	Portulaca oleracea	Lániya-kulfa,	Common.

DIVISION I.—POLYPETALÆ—(*continued*).

No.	Scientific name.	Vernacular name.	Note.
	ORDER 19.—TAMARISCINEÆ.		
1	Tamarix gallica	...	Bhábar.
2	„ dioica	...	„
3	Myricaria germanica	...	Frequent, above 10,000 feet.
4	„ elegans	...	Frequent, above 11,000 feet.
	ORDER 20.—HYPERICINEÆ.		
1	Hypericum (Androsæmum) cernuum,	Ulua-bena ...	Common April.
2	„ cordifolium ...	...	Rare, Ránni
3	„ lysimachioides ...	...	Frequent above 8,000 feet
4	„ patulum [uralum, Don].	...	Common, September.
5	„ (Euhypericum) perforatum	...	„ „
6	„ elodeoides	...	„ August, and September
7	„ nepalense	...	„ August, and September.
8	„ (Brathys) japonicum [pusillum].	...	Low elevations.
	ORDER 21.—TERNSTRŒMIACEÆ.		
1	Eurya acuminata	Deura ...	Common.
2	Actinidia [Trochostigma, Madden] callosa.	...	Bhábar and banks of Sarju.
3	Saurauja nepaulensis	Goganá ...	Common.
4	Camellia thea	Cha ...	Introduced.
	ORDER 22.—DIPTEROCARPEÆ.		
1	Shorea robusta	Sál Sákhu ...	Common up to 4,500 feet, March
	ORDER 23. MALVACEÆ.		
	TRIBE MALVEÆ.		
1	Malva verticillata	...	Frequent.
2	„ sylvestris, [mauritiana, Madden].	Tilchoni ...	Gardens and wild.
3	„ rotundifolia		Common.
4	„ parviflora	...	Up to 2,000 feet
5	Sida rhombifolia	Bhua Kúlauli	Common.
6	„ cordifolia	...	„
7	Abutilon polyandrum	...	Bhábar and up to 3,000 feet.
8	„ indicum	...	
	TRIBE URENEÆ.		
9	Urena lobata	Sújiya Chatkura.	Common, banks of streams.

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name.	Vernacular name	Note.
	ORDER 23.—MALVACEÆ—(concluded)		
	TRIBE HIBISCEÆ.		
10	Hibiscus (Furcaria) furcatus ...	..	Introduced.
11	,, (Lagunea) solandra .	..	Common
12	,, (Abelmoschus) ficulneus ...	..	,,
13	,, pungens	Háo Kapásya	,,
14	,, cancellatus . ..	,,	,,
15	Thespesia lampas	Kapásya ..	
	TRIBE BOMBACEÆ.		
16	Kydia calycina	Patá ..	Common, September
17	Bombax malabaricum [Bombax heptaphyllum, Roxb]	Semal ✓ ...	,, Bhábar, up to 4,800 feet
	ORDER 24.—STERCULIACEÆ		
1	Sterculia urens . ..	Katíra ..	Bhábar.
2	,, villosa .	Udyál .	,,
3	,, (Firmiana) fulgens [Wallichii, Madden]	Bodalá .	Common
4	Helicteres isora	Maror phal,	Bhábar, May,-September.
5	Pterospermum acerifolium ..	Muchkunda,	Introduced
6	,, lanceæfolium [P. suberifolium, Madden]	,, ..	Bháber.
7	Melochia corchorifolia, [Riedleia corchorifolia, Dec]	...	Up to 4,000 feet.
8	Waltheria indica, [Melochia corchorifolia, Wall]	..	,, ,,
	ORDER 25 —TILIACEÆ		
1	Grewia oppositifolia	Bhekla, bhengál	Common
2	,, tiliæfolia ..	..	Frequent, valleys
3	,, asiatica [elastica, Royle, Ill]	Pharsiya ..	Common, cultivated.
4	,, sapida [nana, Wall]	,,	Common.
5	,, scabrophylla [sclerophylla, Wall]	Gar bheli .	,,
6	,, laevigata [didyma, Roxb] .	Bhimul .	,,
7	,, polygama ..	..	Bhábar
8	Triumfetta pilosa [oblongata, Wall]	Leshwa, kumariya	Common.
9	,, rhomboidea [angulata, Wall]	Chat kura ...	Up to 4,000 feet
10	Corchorus fascicularis ? ..	..	Introduced.
11	,, acutangulus ? .	..	,,
12	Elæocarpus Varunna	Ja'pai ...	Rare
	ORDER 26. - LINEÆ		
1	Linum usitatissimum . ..	Alsi ..	Introduced.
2	Reinwardtia trigyna	Pyúra ...	Very common, March.
3	,, tetragyna .	..	Rare

DIVISION I.—POLYPETALÆ—(*continued*).

No.	Scientific name.	Vernacular name.	Note.
	ORDER 27.—MALPIGHIACEÆ.		
1	Hiptage madablota	..	March; common up to 3,000 feet.
2	Aspidopterys Wallichii [Hiræa nutans, Wall.]	...	June, frequent up to 4,000
	ORDER 28.—ZYGOPHYLLEÆ		
1	Tribulus terrestris	...	Common.
	ORDER 29.—GERANIACEÆ		
1	Geranium pratense	... ✓	Rare, Painkanda.
2	" collinum . ..	...	"
3	" palustre? [grandiflorum, Edgeworth]	...	" Mána Pass
4	" Wallichianum ...	..	Common, Naini Tál and Binsar, July
5	" Grevilleanum [eriostemon, Don]	...	"
6	" nepalense	...	Common, May, June.
7	" polyanthes	...	Rare
8	" rotundifolium ...	...	"
9	" molle	..	February Banks of Ganges up to 1,500 feet.
10	" Robertianum ...	..	"
11	" lucidum .. .	..	Common.
12	" ocellatum [bicolor, Royle, Ill.]	Ankrí ...	Very common, April, May,
13	Tropæolum majus	...	Introduced.
14	Oxalis corniculata	Chalmori ...	Very common.
15	" acetosella	..	Rare, Pindari, April.
16	Biophytum sensitivum	...	Common up to 4,000 feet.
17	" Reinwardtii	...	" "
18	Impatiens (Brevicapsulæ) Balsamina,	..	Gardens.
19	" (Longicapsulæ) Roylei *var* moschata, Edge.	...	Common.
20	" Thomsoni	...	12,000 feet
21	" sulcata [gigantea, Edge.],	..	Frequent
22	" amplexicaulis ..	...	Rare
23	" scabrida [tricornis, Lind, Hamiltoniana, Don]	...	Common, May, June.
24	" bicornuta	...	Rare.
25	" amphorata	...	Common, autumn.
	var umbrosa, Edge, [bicolor, Royle, Ill.]	...	"
26	" racemosa	...	Frequent.
27	" laxiflora	...	"
28	" micranthemum ...	...	Rare.
29	" brachycentra ..	.	Frequent, summer.
30	" glauca	...	Rare, Diwáli.

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name.	Vernacular name	Note.
	ORDER 30.—RUTACEÆ		
	TRIBE RUTEÆ		
1	*Bœnninghausenia albiflora, [Ruta albiflora, Wall.]*	Pisu ghás and upanyá ghás	*Very common, autumn*
	TRIBE ZANTHOXYLEÆ.		
2	Zanthoxylum alatum, [Z hostile, Wall]	Timur and tejbal.	Common.
3	,, acanthopodium [hostile, Wall]	Simur ..	Rare, Budh Jageswar
4	,, oxyphyllum .	..	Frequent, Gágar.
5	,, Budrunga ..	...	Rare
	TRIBE TODDALIEÆ.		
6	Toddalia aculeata .. .	Khaseru ..	Bhábar and valleys.
7	Skimmia [Limonia, Wall. AnqueTilia Dece] Laureola	Nehar, kastúri, gúral pata	Very common.
	TRIBE AURANTIEÆ		
8	Glycosmis pentaphylla	Potla ..	Common
9	Murraya exotica	Juti ..	,,
10	,, (Bergera) Kœnigii ..	Gani . .	Very common
11	Clausena pentaphylla .		Bhábar.
12	Limonia acidissima [L crenulata, Roxb]	..	,,
13	Citrus medica	Bijaura ..	,,
	var limonum	Jamíra ...	,,
14	,, aurantium	...	Rare
15	Feronia Elephantum	Kait .	Bhábar.
16	Ægle Marmelos	Bel ...	,,
	ORDER 31.—SIMARUBEÆ.		
1	Picrasma quassioides	...	Valleys ; frequent
	ORDER 32.—OCHNACEÆ.		
1	Ochna pumila	...	Rare.
	ORDER 33—BURSERACEÆ.		
	TRIBE AURANTIEÆ.		
1	Boswellia serrata [thurifera, Roxb.]	Sale, gugar .	Bhábar.
	var. glabra . . .	Gugai ...	,,
2	Garuga pinnata	Khaipat ..	,,
	ORDER 34—MELIACEÆ		
1	Melia Azadirachta [indica] .	Ním ...	Introduced. Bhábar.
2	,, Azedarach [sempervirens Roxb],	Betain .	Common.
3	Heynea trijuga, [Zanthoxylon connaroides, W. & A]	...	Bhábar.
4	Cedrela Toona	Tún ...	Valleys
5	,, serrata .. .	Dál . .	Very common.

DIVISION I —POLYPETEÆ—(*continued*).

No.	Scientific name.	Vernacular name	Note.
	ORDER 35 —OLACINEÆ		
1	Olax scandens	..	Bhábar
2	,, nana	...	Frequent
	ORDER 36 —ILICINEÆ		
1	Ilex dipyrena	Kandáli	Very common.
2	,, odorata	Gar—kaula, garshun.	Frequent
3	,, excelsa	Kandali	Common.
	ORDER 37 —CELASTRINEÆ.		
1	Euonymus grandiflorus [lacerus, Don],	.	Bhábar, & to 3,000 feet
2	,, tingens	Kasuri	Frequent, April
3	,, fimbriatus	.	Rare, 9,000 feet, April.
4	,, frigidus	.	,, 10,000 ,,
5	,, echinatus	..	Frequent, April.
6	,, pendulus [japonicus, Wall],		,,
7	,, Hamiltonianus	Agnu	Common
8	Celastrus paniculata [nutans, Roxb]	Malkágni	March Bhim Tál.
9	Gymnosporia rufa, [Celastrus rufa, Brandis]		Rare.
10	,, Royleana, [C spinosus, Lam],	Gwála-dárim,	Common
11	,, montana [C senegalensis, Lam]		Rare.
12	Elæodendron glaucum, [Roxburghii, W & A., Neerija dichotoma, Roxb]	Shauria jamrasi and dehbri.	Common A white aphis feeds on this tree
13	Microtropis discolor	.	Frequent
	ORDER 38 —RHAMNACEÆ.		
1	Ventilago calyculata [madraspatana, Roxb]	Rakt pita, kála lag	Common.
2	Zizyphus jujuba	Bair	Cultivated.
3	,, nummularia	,,	,,
4	,, vulgaris	,,	,,
5	,, oxyphylla	,,	Frequent up to 6,000 feet.
6	,, xylopyrus	,,	Bhábar
7	,, rugosa	,,	,,
8	Berchemia floribunda	Kála lag	Frequent.
9	,, flavescens	..	,,
10	,, Edgeworthii	.	Rameshwar
11	Rhamnus dahuricus [virgatus, Roxb]	Chadua	Common, April.
12	,, purpureus	..	Common.
13	,, triquetra	Ghont	,,
14	,, procumbens	..	About 7,000 feet ; on limestone
15	Hovenia dulcis	...	Rare ; cultivated
16	Sageretia oppositifolia	Aglaia	Common.
17	Gouania leptostachya	Kála lag	,,
18	,, nepalensis	...	Bhábar.
19	Helinus lanceolatus	...	Common , valleys.

DIVISION.—POLYPETALÆ—(*continued*).

No.	Scientific name	Vernacular name	Note.
	ORDER 39.—AMPELIDEÆ		
1	Vitis (Simplicifoliæ) quadrangularis [Cissus edulis].	Harjora ..	Bhábar
2	„ pallida		Rare
3	„ repanda [rosea, Royle Ill.]		Frequent; Bhábar.
4	„ adnata		Rare
5	„ pedicellata ...		„
6	„ lanata	Purain	Common, May
	„ *var.* rugosa	Asgánja	„ July.
7	„ latifolia	Pan-leguli	„ Bhábar.
8	„ vinifera		Wild?
9	„ parvifolia	Barain	Common.
10	„ (Trifoliatæ) carnosa		Bhábar
11	„ [Ampelopsis, Wight] himalayana.	Chappar-tang.	Common.
12	„ divaricata [tomentosa, W. and A.]	Amila	„
13	„ (Digitatæ) obtecta		„
14	„ (Pedatæ) capriolata [Cissus serrulata, Roxb.]		„
15	„ lanceolaria [Cissus feminea, Roxb.]	Panj-pata ..	Ránibagh.
16	Leea (Simplicifoliæ) macrophylla	..	Frequent.
17	„ (Pinnatæ) alata		„
18	„ aspera	Kurmali ...	Common.
19	„ (Bipinnatæ) sambucina ...		Rare.
	ORDER 40.—SAPINDACEÆ		
	TRIBE SAPINDEÆ		
1	Cardiospermum Halicacabum		Bhábar.
2	Æsculus (Pavia) indica	Pánkar, pangri	Common.
3	Schleichera trijuga ..	Kusam ..	Bhábar.
4	Sapindus Mukorossi ..	Ríta. ..	
	„ *var.* detergens ..	..	Rare.
	„ *var.* acuminatus		Common.
5	Acer (Integrifoliæ) oblongum ...	Patangtiya...	Common; cups are made of the wood
6	„ lævigatum ..	..	Common.
7	Acer (Trilobatæ) pentapomicum ..	...	Bhábar
8	„ (Quinquelobatæ) cæsium	Kilu ...	Frequent.
9	„ villosum [sterculiacium Wall?].	...	8,000 feet; cups made of the wood.
10	„ caudatum [pectinatum Wall.].	..	10,000 feet.
11	„ (Septemlobatæ) pictum [cultratum, Wall.]	..	Very common
	TRIBE DODONEÆ.		
12	Dodonæa viscosa	...	Rare; Bhábar.
	TRIBE MELIANTHEÆ		
13	Melianthus major	...	Introduced.

DIVISION I.—POLYPETALÆ—(*continued*).

No.	Scientific name	Vernacular name	Note.
	ORDER 40.—SAPINDACEÆ—(concluded).		
	TRIBE STAPHYLLÆ.		
14	Staphylea emodi	Chitra ...	Frequent Gágar and Siáhi Debi.
	ORDER 41.—SABIACEÆ.		
1	Meliosma dilleniæfolia	Gwep ..	Common about 7,000 feet
2	„ pungens	Gaidar ..	Frequent, banks of streams
3	Sabia campanulata	Bakal pata ..	Common
4	„ parviflora .. .	.	„ about 5,000 feet
5	„ paniculata	...	„ Bhábar.
	ORDER 42.—ANACARDIACEÆ		
1	Rhus (Simplicifoliæ) cotinus ..	Tung-ami ..	Very common
2	„ (Trifoliatæ) parviflora	Ranel ..	„
3	„ (Impari pinnatæ) semialata	Dakmila .	Common
4	„ Wallichii [vernicifera, Royle],	Bholiao	„
5	„ succedanea [acuminata, Dec.].	Titar .	„
6	Pistacia integerrima, [Rhus integerrima, Wall.]	Kakar singi,	Valleys, common.
7	Odina Wodier . .	Jhingho ..	Common; valleys
8	Semecarpus Anacardium ..	Bhiláwa ..	Bhábar
9	Mangifera indica	Am ...	Common; valleys.
10	Buchanania latifolia	Pial ..	Bhábar
11	Spondias mangifera	Amra ✓ ...	„ and valleys.
	ORDER 43.—CORIARIACEÆ		
1	Coriaria nepalensis	Mansuri mokola.	Common
	ORDER 44.—MORINGEÆ		
1	Moringa pterygosperma. . ..	Sainjan ..	Common; Bhábar.
	ORDER 45.—LEGUMINOSÆ		
	TRIBE PODALYRIEÆ		
1	Piptanthus nepalensis	Shelgari ...	Above 8,000 feet
2	Thermopsis barbata .. .		„ 10,000 „
	TRIBE GENISTEÆ		
3	Argyrolobium flaccidum [Cytisus flaccidum, Royle]	..	Common, July and August, on limestone.
4	„ roseum ..	...	„ „
5	Crotalaria (Diffusæ) humifusa .	Gungri ...	Common.
6	„ „ hirsuta ...	...	Bhábar.
7	„ (Alatæ) alata . ..	Gungri ...	Common, autumn.
8	„ (Calycinæ) mysorensis ..	..	Valley.
9	„ „ albida ..	...	Common
10	„ „ calycina ...	...	Frequent.

DIVISION I.—POLYPETALÆ—(*continued*).

No.	Scientific name	Vernacular name	Note
	ORDER 45.—LEGUMINOSÆ—(continued).		
	TRIBE GENISTEÆ—(concluded)		
11	Crotalaria (Calycinæ) sessiliflora [anthylloides, Lam]		Common
12	„ (Erectæ) sericea ...	Gungri	Valleys, common.
13	„ (Eriocarpæ) tetragona .	.	„
14	„ (Trifoliolatæ) medicaginea,	..	Very common.
15	„ „ incana	...	Naturalized
	TRIBE TRIFOLIEÆ.		
	SECTION DIGITATÆ.		
16	Trifolium pratense	.	Cultivated ; rare.
17	„ repens	...	„ common.
18	Parochetus communis [oxalidifolia, Royle]		Common, damp ground.
	SECTION PINNATÆ.		
19	Trigonella Fœnum-græcum	Methi	Cultivated.
20	„ polyceratia [incisa, Royle]		„
21	„ gracilis . ..	..	July, on limestone
22	„ pubescens	.	Col Davidson
23	„ corniculata .. .	..	Frequent
24	„ emodi	...	Col Davidson
25	Melilotus parviflora	.	Cultivated
26	„ alba	Garila ...	Common.
27	Medicago lupulina .. .	...	„
28	„ denticulata	...	„
	TRIBE LOTEÆ.		
29	Lotus corniculatus	...	Very common
	TRIBE GALEGEÆ.		
30	Cyamopsis psoralioides ..	..	Bhábar
31	Indigofera (Sphæridiophora) linifolia		„
32	„ (Paucifoliolatæ) trifoliata ..	.	„
33	„ „ trita ..	..	Common.
34	„ (Multifoliolatæ) hirsuta	Náná-sakina,	
35	„ Gerardiana [heterantha, Wall	Mús-sakina...	Very common, May
36	„ „ atropurpurea	Kálá-sakina,	Common, August.
37	„ „ pulchella [arborea, Roxb].	Sakina ..	Very common, March.
38	„ „ Dosua [heterantha, Wall	Sakina ✓.	Very common, May, June
39	Colutea arborescens, *var.* nepalensis,		Above 10,000 feet, July, August.
40	Mellettia auriculata [Robinia macrophylla, Roxb]	Gojha ..	Very common; valleys, May
41	Tephrosia candida . .	Lehtia .	Bhábar. Leaves used to poison fish
42	„ purpurea .. .	..	Bhabar.

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name	Vernacular name.	Note.
	ORDER 45.—LEGUMINOSÆ—(continued).		
	TRIBE GALEGEÆ (concluded)		
43	Sesbania ægyptiaca . .	Jait .	Cultivated
44	Caragana pygmæa [Genista, versicolor, Royle]		Common above 10,000 feet
45	„ Gerardiana [Caragana spinosissima, Royle.]	Dámá	„ 8,000 feet, May
46	„ polyacantha ...	„ ..	Rare
47	„ brevispina .. .	„	Common above 8,000 feet
48	„ crassicaulis ..	..	„ „ 12,000 feet
49	Guldenstædtia himalaica .	Dámá	„ „ 11,000 feet
50	Astragalus (Pogonophace) trichocarpus [sesbanoides, Royle] .. .	.. ..	Common.
51	„ (Pololotus) hosackioides	...	Common.
52	„ (Hypoglottis) himalayanus	..	Above 10,000 feet
53	„ „ Maddenianus	...	„ „
54	„ „ leucocephalus ...	...	Common
55	„ (Phaca) chlorostachys ..	.	„
56	„ „ var trichocarpoides Kurz,	.	W. Waterfield, Naini Tál.
57	„ „ emodi . ..	.	Above 10,000 feet
58	„ graveolens ..	..	Frequent
59	„ (Myobroma) Candolleanus ..	..	Above 8,000 feet.
60	„ (Ægacantha) polyacanthus ...	..	Frequent.
	TRIBE HEDYSAREÆ.		
	SECTION EXSTIPELLATÆ.		
61	Onobrychis sativa .	..	Cultivated
62	Lespedeza (Eulespedeza) sericea ...	...	Common.
63	„ „ Gerardiana,		Very common.
64	„ (Oxyrambhis) macrostyla,	..	Common
65	„ „ eriocarpa .	..	„
66	Hedysarum kumaonense ...	...	Rare; found by Strachey and Winterbottom.
67	Zornia diphylla [angustifolia, D.C.]	..	Common.
68	Smithia sensitiva	..	Bhábar.
69	„ geminiflora	...	„
70	„ ciliata	...	Common near streams.
71	Æschynomene indica	...	Up to 4,000 feet.
	SECTION STIPELLATÆ.		
72	Uraria picta	..	Common.
73	„ crinita . ..	..	„
74	„ lagopus . .	.	„
75	„ prunellæfolia . ..	...	Valleys
76	Alysicarpus (Microcalycinæ) vaginalis	...	Common to 4,000 feet.
77	„ (Microcalycinæ) bupleurifolius.	...	„ „

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name	Vernacular name.	Note.
	ORDER 45.—LEGUMINOSÆ—(continued) TRIBE HEDYSAREÆ—(concluded) SECTION STIPELLATÆ (concluded).		
78	Alysicarpus (Microcalyceæ) rugosus,	Saindan asainda.	Common to 4,000 feet.
79	Ougeinia dalbergioides [Dalbergia oojeinensis, Roxb.]		Up to 4,000 feet, March.
80	Desmodium (Phyllodium) pulchellum,	..	Bhábar.
81	" (Pteroloma) triquetrum,		Common
82	" (Scorpiurus) laxiflorum,		" Naini Tál
83	" (Podocarpium) podocarpum		Rare.
84	" (Dollinera) floribundum [multiflorum D. C.]	..	Very common, August
85	" " oxyphyllum [polycarpum, Wall.]	...	Common ; Binsar "
86	" " tiliæfolium [nutans, Wall., argenteum Wall.]	...	Very common, July
87	" (Heteroloma) Gangeticum,	..	Valleys
88	" " latifolium	..	Frequent.
89	" " sequax ...	.	"
90	" " concinnum [penduliflorum, Wall.]	..	Common up to 7,000 feet.
91	" (Nicolsonia) polycarpum D C [angulatum, Wall.]	...	"
92	" (Sagotia) triflorum	..	Very common, autumn
93	" " parviflorum .	...	"
94	" (Pleurolobium) gyrans	..	Common
95	" " gyroides	...	Bhábar
	TRIBE VICIEÆ		
96	Abrus precatorius . ..	Gunchi rakti,	Bhábar and valleys.
97	" pulchellus . .	Laguli-imli,	"
98	Cicer arietinum .	Chana ..	Cultivated ; Bhábar.
99	" soongaricum [microphyllum, Royle.]	..	About 12,000 feet ; rare
100	Vicia (Ervum) tetrasperma .	...	Rare
101	" " hirsuta	Kuri .	In cultivated fields.
102	" (Cracca) tenera .	.	Frequent ; Adwani, April
103	" " mollis .. .	..	High levels ; rare.
104	" " pallida	.	Common
105	" " rigidula .		Rare
106	" (Euvicia) sativa . .	Kur-kosha	Cultivated
107	Lathyrus (Eulathyrus) aphaca .	Ghora-kolon,	Common
108	" " sativus	Matar .	Cultivated
109	" " sphæricus [angulatus, Royle.]	Ningla-kosha,	Common
110	" (Orobus) luteus ...	...	Frequent
111	Pisum sativum	Kolai ..	Cultivated
112	" arvense	"	Cultivated and wild.

DIVISION I.—POLYPETALÆ—(*continued*).

No.	Scientific name.	Vernacular name	Note.
	ORDER 45.—LEGUMINOSÆ—(continued).		
	TRIBE PHASEOLEÆ.		
	SECTION GLYCINEÆ.		
113	Shuteria vestita, *var.* involucrata	..	Common.
	„ *var.* densiflora	...	Rare
114	Dumasia villosa	.	Common.
115	Glycine soja [Soja hispida, Mœnch,]	Bhat	Cultivated; very common.
	SECTION ERYTHRINEÆ		
116	Mucuna atropurpurea	Baldaka	Bageshwar.
117	„ pruriens	Goncha	Valleys; common, May
118	Erythrina indica	Rungra	February; Bhábar.
119	„ resupinata	..	Frequent; Háwalbagh, March and October
120	„ suberosa	Rungra	March, up to 4,000 feet
121	„ arborescens	„	August, common.
	SECTION GALACTEÆ		
122	Spatholobus Roxburghii [Butea parviflora, Roxb.]	Maola	Bhábar
123	Butea frondosa	Dhák	Up to 4,000 feet.
124	Butea superba	...	Near Taili Mainari hill Loch, September.
125	Pueraria tuberosa	Bilil-kand	Very common, March, April.
126	„ Stracheyi	..	Rare; Kálimandi, 7,300 feet
	SECTION EUPHASEOLEÆ.		
127	Phaseolus vulgaris	..	Cultivated; Bhábar gardens
128	„ trilobus	Chhihin	„ Bhábar.
129	„ aconitifolius	Moth	„ Bhábar.
130	„ mungo	Múng	„ not common.
	„ „ *var.* radiatus	Urd	„ common.
131	„ calcaratus [torosus, Roxb.]	Gurush	„ and wild red and white varieties
132	Vigna (Euvigna) catiang [Dolichos sinensis, Linn.]	Riansh	„ common, three varieties
	„ „ *var.* sinensis	Lobiya	„
133	„ (Plectropis) vexillata [Phaseolus angustifolius, Wall.]	Ban-mung	Very common, autumn.
134	Pachyrrhizus angulatus	...	Cultivated; Bhábar, root edible.
135	Dolichos Lablab	Shími	Gardens, cultivated up to 7,000 feet.
136	„ biflorus [uniflorus, D. C.]	Gahat	Cultivated up to 3,000 feet.
137	„ falcatus	Gahatíya?	Common.

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name	Vernacular name	Note.
	ORDER 45.—LEGUMINOSÆ—(continued)		
	TRIBE PHASEOLEÆ—(concluded)		
	SECTION CAJANEÆ.		
138	Atylosia (Atylia) mollis ..	.	Common
139	" " grandiflora	.	Rare, Bageshwar.
140	" " [Cantharospermum] scarabæoides	..	Common, Bhábar and outer hills
141	" " platycarpa,		Rare.
142	Cajanus flavus .	Arhar ...	Cultivated: Bhábar
143	Eriosema chinense [Crotalaria tuberosa, Don]	.	Common; Simtola hill.
144	Rhynchosia pseudo-cajan ...	Shiali, phá-sarpata.	"
145	" minima .		Low elevations; rare.
146	" himalensis	..	" "
147	Flemingia (Ostryodium) strobilifera,	. .	Very common.
	" var. fruticulosa	. .	"
148	" " Chappar .	..	Rare
149	" (Chalaria) paniculata		At low elevations.
150	" (Flemingiastrum) congesta [semialata]	Bhatua .	Common.
	" " var. nana .	...	Common.
151	" (Rhynchosioides) vestita,	Muskila ..	Edible tuber; common
	TRIBE DALBERGIEÆ.		
	SECTION ALTERNIFOLIOLATÆ.		
152	Dalbergia Sissoo	Sisu .	Bhábar and valleys.
153	" rimosa . ..	...	" "
154	" lanceolaria [frondosa, Roxb.]	...	Frequent.
155	" volubilis . .	Bhatia	Common
156	Pterocarpus marsupium	Bijai-sál	Near Barmdeo
	SECTION OPPOSITIFOLIOLATÆ		
157	Pongamia glabra .. .	Pit pápar ...	Bhábar, April
158	Derris robusta .. .	Baro .	Up to 5,000 feet
	TRIBE SOPHOREÆ		
159	Sophora mollis [Edwardsia mollis, Royle].	Pahár-gingri,	Very common, March.
	TRIBE CÆSALPINIEÆ		
160	Cæsalpinia [Guilandina] Bonducella,	Karonj ...	Up to 2,500 feet.
161	" [Poinciana] pulcherrima,	Krishna chura	Garden
162	" " sepiaria ..	Aira	Common.
163	Parkinsonia aculeata	Wiláyati kikar.	Introduced.
164	Poinciana regia	..	Gardens, rare.

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name.	Vernacular name.	Note
	ORDER 45.—LEGUMINOSÆ—(continued).		
	TRIBE CASSIEÆ.		
165	Cassia (Fistula) Fistula ...	Rajbriksh, kitota	May, June, up to 4,000 feet
166	„ (Senna) occidentalis .	Banár .	Bhábar
167	„ „ Sophera [purpurea, Roxb.],	„ .	„
168	„ „ Tora ...	„ .	Common
169	„ „ angustifolia [lanceolata, *Royle*]	Sanna, makki.	Cultivated; Bhábar.
170	„ (Psilorhegma) glauca [arborescens, Roxb.	...	Bhábar.
171	„ (Lasiorhegma) Absus [coccinea, Wall.]	Banár ..	Common.
172	„ „ pumila	Silpatiya ..	„
173	„ „ mimosoides ...	„ ..	Very common.
..	„ „ *var* dimidiata ..	„ ...	Common
..	„ „ *var* Wallichiana	„ ..	„
	TRIBE AMHERSTIEÆ.		
174	Saraca indica [Jonesia asoka, Roxb.]	Asok ..	Introduced; Sítaban, Bhábar
	TRIBE BAUHINIEÆ.		
175	Bauhinia (Decandræ) racemosa [parviflora Vahl.]	...	Up to 5,000 feet, common, April.
176	„ „ malabarica ...	Amli ..	Rare, October
177	„ (Triandræ) retusa [emarginata, Wall.]	Kándla	*Common, September.*
178	„ „ Vahlii ...	Málu ...	Very common, April, May.
179	„ „ purpurea ..	Khairwál ..	Bhábar and valleys, October.
180	„ (Pentandræ) variegata .	„	Common, April.
...	„ „ *var* candida, ..	...	„
	TRIBE MIMOSEÆ.		
181	Entada scandens	...	Rare.
182	Parkia biglandulosa ..	...	Cultivated; Bhábar.
183	Leucæna glauca [Acacia frondosa,.. D. C.]	...	Common, valleys, July.
184	Mimosa pudica	Lajwanti ..	Naturalized, Bhábar.
185	„ rubicaulis [octandra, Roxb.],	Agla ..	August, common up 4,000 feet.
	TRIBE ACACIEÆ.		
186	Acacia (Globiferae) Farnesiana ...	Wiláyati babúl.	Bhábar and valleys.
187	„ „ arabica ..	Babúl ...	„
188	„ „ eburnea ..	Bhes ...	Banks of streams.
189	„ (Spicatae) Catechu ...	Khair ...	Very common; Bhábar.
190	„ „ modesta ...	Phulai ...	Rare, Bhábar.
191	„ „ lenticularis .	Khain ...	Barmdeo
192	„ (Vulgares) concinna [rugata, D.C.],	Ban-rítha ...	Bhábar
193	„ „ Intsia [Cæsia, Linn.]	Katrai ...	*Very common, Bhábar.*
194	„ „ pennata ..	Agla	„ „

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name.	Vernacular name.	Note
	ORDER 45.—LEGUMINOSÆ—(concluded).		
	TRIBE INGEÆ.		
195	Albizzia (Multifoliolatae) Lebbek ..	Tantiya, balsís	Common, April, June
196	" " odoratissima ...	Siris ...	Bhábar, April, June
	" " *var* mollis ..	" ..	" "
197	" " procera .	Baro	" May
198	" " Julibrissin ..	Lál siris ...	Up to 5,000 feet, May
199	" " stipulata [Smithiana, Wall	.	Up to 4,000 feet, May.
200	" Paucifoliolatae) lucida		Bhábar, April
201	Pithecolobium (Unguis-cati) dulce	Wiláyati imli, Dakhni babúl.	Gardens, Bhábar.
202	" Clypearia) bigeminum	Kachhora	Up to 3,000 feet, April.
	ORDER 46.—ROSACEÆ		
	TRIBE PRUNEÆ		
1	Prunus (Amygdalus) persica ...	Aru ...	Cultivated, very common
2	" (Armeniaca) armeniaca ...	Chuáru and zardálu	"
3	" (Cerasus) avium ...		Cultivated up to 8,000 feet
4	" " cerasus ..	...	"
5	" " Jacquemontii ..	Padam puya	Rare, Malári, Edgeworth
6	" " Puddum .	.	Very common, November
7	" (Euprunus) communis *var.*, domestica *var*	Bhotiya badám.	Cultivated; Almora
	" " "	Ladaki ...	"
8	" (Laurocerasus) Padus [cornuta, Royle].	Jáman .	Common.
9	" " nepalensis ..	"	About 6,000 feet.
10	" " undulata [capricida, Wall]	"	"
11	Prinsepia utilis	Bekla, jhatila,	Very common.
	TRIBE SPIRÆÆ.		
12	Spiræa (Ulmaria) vestita [Kamtschatica, Lindley	...	Above 8,000 feet.
13	" (Aruncus) aruncus [triternata, Wall]	...	" 10,000 feet.
14	" (Sorbaria) sorbifolia [Lindley and Wall]	Dhauiyáli ...	" 8,000 "
15	" (Chamædrys) bella ..	Jhár ...	Common.
16	" " canescens [cuneifolia, Wall]	" .	"
17	" " vaccinifolia ..	...	Rare

DIVISION I.—POLYPETALÆ—(*continued*).

No.	Scientific name.	Vernacular name	Note.
	ORDER 46.—ROSACEÆ—(continued)		
	TRIBE RUBEÆ.		
18	Rubus (Simplicifoliæ) calycinus [Dalibarda calycina, D C]	.	Rare.
19	,, ,, acuminatus	Lál hisálu ..	,,
20	,, ,, paniculatus [tiliaceus, Wall]	Kálá ,, ..	Common
21	,, ,, moluccanus [rugosus, Smith]	Lál ,, ...	,, low levels.
22	,, ,, reticulatus .	Kálá ,, ...	,, high levels
23	,, ,, lanatus [tiliaceus, St & W]	,,	About 6,000 feet.
24	,, (Digitatæ) alpestris .	..	Rare.
25	,, (Trifoliatæ) saxatilis ..	Lál hisálu .	Above 10,000 feet
26	,, ,, nutans .	Pingla ,, gangur	Very common at high elevations
27	,, ,, niveus ...	Lál ,, .	Very common.
..	,, ,, *var.* concolor	Pingla ,, ..	Common, China hill.
28	,, ,, macilentus [asper Royle]	,, ,, .	,,
29	,, ,, ellipticus [rotundifolius, Wall; Gowry-phul, Roxb. flavus, Don]	Hisálu .	March, very common Fruit much eaten in April and May
30	,, (Pinnatæ) biflorus ...	Pingla hisálu,	Frequent.
31	,, ,, lasiocarpus [rosæflorus, Roxb.]	Kálá ,, ..	Very common, Bhábar, and up to 7,500 feet.
32	,, ,, foliolosus ...	Safed ,, ...	Frequent
.	,, ,, rosæfolius ..	Lál ,, ..	...
	TRIBE POTENTILLEÆ.		
33	Geum (Eugeum) urbanum ..	.	Rare
34	,, (Sieversia) elatum [Potentilla adnata, Wall]	.	Common, above 8,000 feet.
35	Fragaria (Duchesnea) indica ...	Kaphaliya .	,, up to 8,000 feet.
36	,, (Eufragaria) vesca [nubicola, Wall]	...	,, above 7,000 feet.
37	Potentilla (Sibbaldia) Sibbaldi .	...	,, Dákuri, at 10,000 feet.
38	,, ,, axilliflora ...	..	Rare.
39	,, (Trichothalamus) fruticosa	...	Above 12,000 feet
40	,, ,, ambigua	..	Colonel Davidson.
41	,, ,, eriocarpa	...	Above 12,000 feet.
42	,, (Eupotentilla) Mooniana [polyphylla, Wall]	...	High elevations.
43	,, ,, fulgens [splendens, Wall]	...	Common.
44	,, ,, Leschenaultiana,	..	,
45	,, ,, fragarioides .	.	Very common
46	,, ,, peduncularis .		Rare, Malári
47	,, ,, leuconota ..	...	Rare, high levels
48	,, ,, microphylla ...	...	,,

DIVISION I.—POLYPETALÆ—(*continued*).

No.	Scientific name.	Vernacular name	Note
	ORDER 46.—ROSACEÆ—(continued)		
	TRIBE POTENTILLEÆ—(concluded)		
49	Potentilla (Eupotentilla) multifida	.	Rare, Niti pass, 16,000 feet.
50	„ „ sericea ..	...	Rare, high elevations
51	„ „ nepalensis .	..	Common
52	„ „ argyrophylla .	.	Rare
.	„ „ *var.* atrosanguinea	.	Common.
53	„ „ nivea ..	...	Rare, high elevations
54	„ „ Kleiniana	..	Common.
55	„ „ supina ..		„
	TRIBE POTERIEÆ		
56	Agrimonia Eupatorium ..	..	Common, June, July.
	TRIBE ROSEÆ		
57	Rosa (Eleutherostylae) macrophylla.	...	Frequent; China and Binsar
58	„ „ Webbiana ..	..	Above 8,000 feet, common.
59	„ „ sericea [tetrapetala, Royle]	...	„ „
60	„ (Systylae) moschata [Brunonis, Wall]	...	Very common; May-June
	TRIBE POMEÆ		
61	Cydonia vulgaris .	Bihi ...	Cultivated up to 5,000 feet.
62	Eriobotrya japonica . .	Loquat ..	„ Bhábar
63	Pyrus (Malus) malus	Seb ...	„ and perhaps wild
64	„ „ baccata	Ban mehol ...	Common; sometimes cultivated.
65	„ (Eupyrus) communis ..	Nashpáti ..	Cultivated
66	„ „ Pashia [variolosa, Wall]	Mehal ..	Very common
67	„ „ kumaoni .	„ .	Common
68	„ (Aria) lanata	Gálion .	Above 8,000 feet, common
69	„ „ vestita .. .	Mauli ..	Common.
70	„ (Sorbus) Aucuparia ...	...	Above 12,000 feet.
71	„ „ foliolosa [ursina, Wall].	Salia halia .	„ 8,000 feet, very common
72	Stranvæsia glaucescens [Photinia dubia, Madden]	Garmehal, sund	Very common about 5,000 feet
73	Cratægus Oxyacantha	.	Cultivated; rare
74	„ crenulata .	Gingáru .	Very common
75	Cotoneaster (Planifolia) bacillaris ..	Ruus, ruis .	Common. Walking sticks made of the wood

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name	Vernacular name.	Note.
	ORDER 46.—ROSACEÆ (concluded)		
	Tribe Pomeæ (concluded)		
76	Cotoneaster (Planifolia) acuminata .	Rans, rois . .	Common. Walking sticks made of the wood
77	„ „ multiflora	..	Rare ; Niti pass.
78	„ „ nummularia ..	..	Colonel Davidson.
79	„ (Recurvifolia) microphylla	Gan ...	Very common everywhere.
80	„ „ *thymifolia* ..	„ ...	*Common.*
81	„ „ buxifolia .	„ ...	„
	ORDER 47.—SAXIFRAGACEÆ		
	Tribe Saxifrageæ.		
1	Astilbe rivularis [Spiræa barbata, Wall],	...	Common
2	Saxifraga (Nephrophyllum) odontophylla.	...	Above 10,000 feet.
3	„ (Hirculus) palpebrata ...	...	Rare ; found near Rálam at 13,000 feet.
4	„ „ saginoides ..	...	„ „
5	„ „ diversifolia ..	. .	„ 10,000 „
6	„ (Boraphila) micrantha ..	...	„ 10,000 „
7	„ (*Microphylla*) *imbricata*	..	„ *12,000* „
8	„ (Spinulosæ) brachypoda .	...	„ 10,000 „
9	„ „ fimbriata ..	..	„ 11,000 „
10	„ „ filicaulis ...	..	„ 10,000 „ Pindari.
11	„ (Flagellares) Brunoniana,	...	China peak
12	„ (Bergenia ligulata .	Silphora . .	March ; very common.
.	„ „ *var* ciliata, Royle	„ ...	Very common.
13	Chrysosplenium (Oppositifolia) nepal*ense*	...	Common
.	„ „ *var.* sulcatum,	...	„
14	„ „ trichospermum,	..	„
15	„ (Alternifolia) tenellum ..	...	Near Kedár Kánta.
16	Parnassia nubicola	...	Common
	Tribe Hydrangeæ.		
17	Hydrangea (Truncatæ) altissima ...	...	Frequent.
18	„ „ aspera ...	Bhujhata ...	„
19	„ „ (Coronatæ) vestita.	„ . .	„
20	Deutzia corymbosa	...	May, common, high elevations.
21	„ staminea	...	May, very common.
22	„ macrantha	...	May, rare.
23	Philadelphus coronarius, *var* tomentosus.	Bukyal, dhaniyali.	June, frequent at high elevations. Wán.
	Tribe Escallonieæ		
24	Itea nutans	Garkath . .	Common at low elevations.

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name.	Vernacular name	Note.
	ORDER 47.—SAXIFRAGACEÆ—(concluded).		
	TRIBE RIBESIÆ		
25	Ribes (Grossularia) grossularia ..	..	Common about 10,000 feet
26	„ (Ribesia) glaciale [acuminatum, Wall].	Kokaliya ..	„ above 10,000 feet
27	„ „ nigrum	Páphar ...	„ about 10,000 feet.
28	„ „ rubrum . .	„ ...	„ „
	ORDER 48.—CRASSULACEÆ		
	TRIBE ISOSTEMONES		
1	Tillæa pentandra . ..	.	Common
2	Crassula indica ..	..	Frequent, Gágar
3	Cotyledon oreades	...	Above 13,000 feet.
	TRIBE DIPLOSTEMONES OPPOSITIFOLIA.		
4	Bryophyllum calycinum .	.	Bhábar; introduced.
5	Kalanchoe spathulata [varians, Wall],	Bakal patta,	Very common Goats poisoned by eating this plant
	TRIBE DIPLOSTEMONES ALTERNIFOLIA.		
6	Sedum (Rhodiola) Rhodiola [rosea, Linn]	..	Common above 12,000 feet
7	„ „ crenulatum ..	...	Frequent above 12,000 feet
8	„ „ quadrifidum ..	...	Common above 12,000 feet
9	„ „ asiaticum	...	„ above 11,000 feet
10	„ „ linearifolium ..	.	„ on trees.
11	„ „ trifidum [sinuatum, Royle]		„ „ September
12	„ (Eusedum) rosulatum .	..	Common, April May.
13	Sedum [Eusedum) adenotrichum .	..	Common, April, and May.
14	„ „ trullipetalum .	...	Above 11,000 feet.
15	„ „ Ewersii [rubrum .. Royle]		Frequent.
16	„ „ multicaule	...	Common, July
17	Sempervivum mucronatum .		Above 10,000 feet.
18	„ sedoides ..	..	„ 10,000 feet
	ORDER 49.—DROSERACEÆ		
1	Drosera Burmanni	...	Bhábar
2	„ peltata . ..		Very common.
	ORDER 50.—HALORAGEÆ.		
1	Myriophyllum spicatum		Naini Tál lake.
2	Callitriche verna	...	„

DIVISION I.—POLYPETALÆ—(*continued*).

No.	Scientific name.	Vernacular name	Note
	ORDER 51.—COMBRETACEÆ.		
	TRIBE COMBRETEÆ		
1	Terminalia (Catappa) belerica ...	Bahera ...	Frequent, Ganai, March.
2	„ „ Chebula ...	Har, harira,	Common up to 5,000 feet, April, May
3	„ (Pentaptera) Arjuna [glabra, Roxb].	Sáj ...	Bhábar, April, May.
4	„ „ tomentosa ...	„ ...	Common up to 4,000 feet, April.
5	Anogeissus latifolius	Bákla ...	„ outer range.
6	Combretum (Poivrea) decandrum ..	..	„ Feb., March
7	„ (Eucombretum) nanum...	Pharsiya ...	Bhábar, very common, March, April.
8	Quisqualis indica	...	„ gardens
	ORDER 52.—MYRTACEÆ.		
	TRIBE LEPTOSPERMEÆ		
1	Eucalyptus obliqua	Stringy bark,	Introduced.
2	„ globulus ...	Blue gum ...	„
	TRIBE MYRTEÆ.		
3	Psidium Guyava	Amrúd ...	Introduced.
4	Myrtus communis	Wiláyati mendhi.	Cultivated, up to 8,000 feet.
5	Eugenia (Jambosa) Jambos ...	Guláb jáman,	Cultivated; Bhábar
6	„ (Syzygium) operculata ...	Rái „	Bhábar.
7	„ „ Jambolana ...	Jáman.	„ and valleys
	TRIBE BARRINGTONIEÆ.		
8	Barringtonia acutangula ...	...	Banks of streams; Bhábar.
9	Careya herbacea	...	Bhábar, March.
10	„ arborea	Kumbh ...	„ „
	ORDER 53.—MELASTOMACEÆ.		
1	Osbeckia chinensis [angustifola,Don].	Kukar-makri,	Frequent, autumn.
2	„ stellata	„ „	Common „
	ORDER 54.—LYTHRACEÆ.		
	TRIBE AMMANNIEÆ.		
1	Ammannia (Rotala) peploides ...	...	Rare. In damp places.
2	„ „ rotundifolia ...	Darmiya ...	Very common „
3	„ (Euammannia) salicifolia,	...	Bhábar swamps, and up to 4,000 feet
4	„ „ senegalensis,	...	Frequent up to 5,000 feet.

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name.	Vernacular name	Note
	ORDER 54.—LYTHRACEÆ—(concluded)		
	TRIBE LYTHREÆ.		
5	Woodfordia floribunda [Grislea tometosa, Roxb.]	Dhai ...	Very common, April.
6	Lawsonia alba ..	Mendhi ..	Common gardens
7	Lagerstrœmia (Velaga) indica ...	Gulbahár	August, common, gardens
8	" " parviflora ..	Dhaura .	Very common, Bhábar
9	" (Adambea) Flos-Reginæ,	Járul .	Rare. Gardens.
10	Punica Granatum .	Dárim .	Very common up to 5,000 feet
	ORDER 55.—ONAGRACEÆ		
	SECTION POLYSPERMÆ.		
1	Epilobium (Chamænerium) angustifolium.	...	Frequent
2	" " latifolium ..	.	High elevations.
3	" (Lysimachion) hirsutum,	.	Common.
4	" " roseum ...	.	Bhím Tál.
5	" " tetragonum .	..	Naini Tál
6	" " laxum, Royle,	..	
7	Aenothera rosea	...	Naturalized.
8	" nocturna	.	"
9	" grandiflora	.	"
	SECTION OLIGOSPERMA.		
10	Circæa lutetiana [repens, Wall] ..	...	Common.
	" alpina [intermedia, Wall] ..	.	"
	ORDER 56.—SAMYDACEÆ		
1	Casearia graveolens	Chila, chilra	Fruit used to poison fish.
	" tomentosa	" "	" "
	ORDER 57.—PASSIFLORACEÆ.		
1	Passiflora, species .. .	...	Cultivated.
	ORDER 58.—CUCURBITACEÆ		
	SECTION SIGMATOPTERÆ.		
1	Trichosanthes palmata . ..	Indráyan ...	Common.
2	" cucumerina .		Bhábar
3	" anguina	Chichinda .	Cultivated
4	Herpetospermum candigerum ..	.	Rare
5	Lagenaria vulgaris ..	Lauka, lauki, tumri	Cultivated
6	Luffa ægyptiaca [pentendra, Roxb.]	Ghia torai	"
7	" acutangula [triandra] ..	Torai ..	"
8	Benincasa cerifera	Bhuja, petha, kumhra.	"
9	Momordica Charantia	Karela ..	"

DIVISION I.—POLYPETALÆ—(*continued*).

No.	Scientific name.	Vernacular name	Note.
	ORDER 58.—CUCURBITACEÆ—(concluded)		
	SECTION STOMATOPIRÆ—(concluded).		
10	Momordica *dioica*	...	Frequent
11	Cucumis trigonus	Airálu	Common
12	„ Melo [utilissimus, Roxb.]	Kakri	Cultivated.
13	„ *sativus*	*Kakri, khíra,*	„
14	Citrullus Colocynthis	Tumbaza	Wild and cultivated.
15	„ vulgaris	„	Cultivated.
16	Cephalandra indica [Coccinia indica, W. and A.]	Kunderu	Bhábar.
17	Cucurbita maxima	Kadu	Cultivated.
	SECTION ORTHOPIRÆ.		
18	Bryonia laciniosa	..	Common.
19	Mukia scabrella	..	„
20	Zehneria umbellata	Gwala-kakri,	„
	„ *var.* nepalensis	...	„
21	Melothria odorata	..	Rare.
22	Edgaria darjeelingensis	.	„
23	Gynostemma pedata	...	„
	ORDER 59.—BEGONIACEÆ.		
1	Begonia (Knesebeckia) picta	.	Common, autumn.
2	„ (*Trilobaria*) *amœna* [*tenella*, Don.].	...	„ „
	ORDER 60.—DATISCACEÆ		
1	Datisca Cannabina	Bhang-jala .	Common.
	ORDER 61.—CACTACEÆ.		
1	Opuntia Dillenii	Nág-phansa,	Introduced. Common up to 6,000 feet
	ORDER 62.—FICOIDEÆ.		
1	Trianthema crystallina	..	Bhábar.
2	„ pentandra	.	„
3	Mollugo stricta	...	Common.
	ORDER 63.—UMBELLIFERÆ.		
	SECTION HETEROSCIADIÆ		
1	Hydrocotyle javanica	...	Common.
2	„ rotundifolia	...	Rare.
3	„ asiatica	...	Bhábar
4	Sanicula europæa [elata, Don.]	...	Common, June, Bánjbagr.

DIVISION I.—POLYPETALÆ—(*continued*).

No	Scientific name.	Vernacular name	Note
	ORDER 63.—UMBELLIFERÆ—(concluded).		
	SECTION HAPLOZYGIÆ.		
	TRIBE AMMINIÆ.		
5	Vicatia conifolia	...	Kháti Pindari, May.
6	„ Stewartii .	.	Rare, Garhwál
7	Bupleurum lanceolatum . .	...	Common, June, Bánjbagr
8	„ Candollii . .	. .	Above 8,000 feet
9	„ diversifolium		„ 7,000 „
10	„ falcatum, *var.* marginata,	.	Naini Tál, common.
11	„ longicaule ..		Above 8,000 feet
12	„ tenue . .	.	Common.
13	Carum (Glabræ) Carui .	.	Rare
14	„ (Hispidæ) Roxburghianum		Cultivated
15	„ „ anethifolium	.	Almora, common
16	Pimpinella (Glabræ) achilleifolia .	.	Common.
17	„ [Reutera, Edgw.] acuminata.	...	Naini Tál, common
18	„ [Acronema, Edgw.] tenera	...	Naini Tál, on oaks, common
19	„ (Papillosæ) diversifolia trifoliata, Wall	Dhanjari .	Very common
20	„ „ Stracheyi . .		Rare, banks of Dhauli.
21	„ „ cæspitosa	..	„ „
22	Osmorhiza Claytoni [laxa, Royle] .	..	Frequent.
23	Chærophyllum villosum	..	„
	„ reflexum ..	.	Rare.
	TRIBE SESELINIÆ		
24	Seseli trilobum	...	Rare, Niti and Milam.
25	Fœniculum vulgare [panmorium, Roxb.]	Sonf .	Cultivated
26	Œnanthe stolonifera ...		Low elevations, common
27	Ligusticum marginatum ..	...	Naini Tál, common
28	„ elatum [Cortia elata, Edgw.]	...	„ „
29	Selinum tenuifolium [Selinum Candollii, Edgw.]	...	Common
30	„ vaginatum [Cortia vaginata, Edgw.]	..	Frequent.
31	Cortia Lendeii	...	„
32	Pleurospermum [Hymenolæna, D.C.] Govanianum	...	High elevations
33	„ Candollii. „	...	„
34	„ angelicoides „	...	Rare, Rálam river, 11,500 feet.
35	„ dentatum „	...	Frequent.
36	„ stellatum „	...	Rare, Milam glacier.
37	„ densiflorum „	.	High elevations

DIVISION I.—POLYPETALÆ—(*concluded*).

No	Scientific name.	Vernacular name	Note.
	ORDER 63—UMBELLIFERÆ—(concluded).		
	SECTION HAPLOZYGIÆ—(concluded)		
	TRIBE PEUCEDANEÆ.		
38	*Peucedanum graveolens* [*Anethum sowa*, Roxb.]	*Soa* ...	Cultivated.
39	„ Dhana	...	Up to 4,000 feet.
40	Heracleum Brunonis . ..	...	Rare
41	„ candicans	...	Common.
42	„ nepalense	..	Frequent.
	SECTION DIPLOZYGIÆ		
43	Coriandrum sativum	Dhaniya ...	Cultivated.
44	Daucus Carota .	.	„
45	Caucalis Anthriscus . .	.	Very common.
	ORDER 64—ARALIACEÆ.		
	SECTION IMBRICATÆ		
1	Aralia cissifolia .	...	Rare.
2	„ cachemirica [Panax tripinnatum, Wall.]		Pindari, autumn.
3	Pentapanax parasiticum .	Kot semal ..	Up to 7,000 feet
4	„ Leschenaultii, *var.* umbellatum [Hedera fragrans, Don] [Panax bijugum, Wall]	...	„
	SECTION VALVATÆ		
5	Heptapleurum impressum [tomentosum, Don]	..	Common
6	„ elatum .. .	.	Rare.
7	„ venulosum [Hedera terebinthacea, Wall]	..	Up to 3,000 feet
8	Heteropanax fragrans [Panax fragrans, Roxb]	..	Low elevations, November
9	Hedera helix, *var* æsculifolia	Bánda ...	Very common.
	ORDER 65—CORNACEÆ.		
1	Alangium Lamarckii [hexapetalum, Roxd., decapetalum, Wight].	...	Bhábar, rare March.
2	Marlea begoniæfolia ...	Tumri ...	Bageswar, May
3	Cornus macrophylla	Kágshi ..	Common, May
4	„ oblonga ...	.	Frequent, September.
5	„ nervosa, Royle ..		Rare.
6	„ capitata [Benthamia fragifera],	Bamaura ...	Common. Fruit edible, summer.

DIVISION II.—MONOPETALÆ.

No.	Scientific name.	Vernacular name.	Note
	ORDER 1.—CAPRIFOLIACEÆ.		
	TRIBE SAMBUCEÆ.		
1	Viburnum cotinifolium, Don ..	Gwiya .	Very common, June.
2	„ Mullaha, Don [stellulatum, Wall.]	Lál titmuliya,	Common, July
3	„ cylindricum, Don [coriaceum, Blume]	Kála titmuliya,	„ January
4	„ punctatum, Don [acuminatum, Wall.].	...	Common, Binsar, July.
5	(Triloculares) nervosum, Don. [grandiflorum, Wall.]	...	„ Upper Sárju.
6	„ erubescens, Wall] ..	..	Common, April-June
	TRIBE LONICEREÆ.		
7	Triostium himalayanum .	Dur-bank .	Above 8,000 feet.
8	Abelia triflora	Munri .	Common, June
9	Lonicera diversifolia, Wall. [L. quinquelocularis, Hard]	Bhat-kukri,	„ June and July
10	Lonicera orientalis [Govaniana] ..		Rare, Bhatkot, June.
11	„ alpigena [Webbiana, Wall]		Rare, Pindari, June
12	Leycesteria formosa [Lonicera quinquelocularis, Hard]	Nalkaru, karnaliya	Common Confused by Hardwicke with No. 10
	ORDER 2.—RUBIACEÆ.		
	TRIBE NAUCLEÆ		
1	Anthocephalus (Nauclea) Cadamba,	Kadam .	Cultivated, June
2	Adina (Nauclea) cordifolia ..	Haldu ...	Common; Haldwáni, July.
3	Stephegyne (Nauclea) parvifolia	Phaldu ...	„ Bhábar, June.
	TRIBE CINCHONACEÆ.		
4	Hymenopogon parasiticus ...	Bhainai ya-padera	On oaks at Binsar.
5	Hymenodictyon excelsum . .	Bhalena . .	Common, June.
6	„ flaccidum	.	Rare, June
7	Wendlandia exserta [W. cinerea Rondeletia exserta]	Chilkiya ...	Common, March
8	„ tinctoria ...	...	Bhábar, February.
	TRIBE HEDYOTIDEÆ.		
9	Argostemma sarmentosum ..	. .	Frequent
10	Hedyotis Lindleyana ..	.	Common
11	„ calycina	.	„
12	Oldenlandia Burmanniana ..	. .	„
13	„ (Kohautia) coccinea .	..	„
14	„ gracilis . ..	.	„
15	„ stipulata .. .		Rare
16	Ophiorhiza nana .		„
17	„ Mangus . .	. .	„
18	„ bracteolata . ..	.	„

DIVISION II.—MONOPETALÆ—(*continued*).

No.	Scientific name	Vernacular name.	Note.
	ORDER 2.—RUBIACEÆ—(concluded)		
	Tribe Gardeniæ.		
19	Gardenia turgida [longispina, Madden.]	Thanela .	Bhábar
20	„ latifolia	Pindálu . .	„
21	Randia tetrasperma	Bhotiya gingárn and Bara gari.	Very common.
22			
23	„ dumetorum	Mainphal . .	Bhábar
	„ uliginosa . ..	Pindálu. ..	„
	Tribe Knoxieæ.		
24	Knoxia mollis	...	Frequent.
	Tribe Ixoreæ.		
25	Pavetta tomentosa [Ixora tomentosa, Roxb.]	Padera ...	Common.
26	Coffea bengalensis, ...	Kath jahi .	Frequent, March
	Tribe Pæderieæ		
27	Hamiltonia scabra, Dec [suaveolens, *var* azurea, Wall.]	Jogiya-padera,	Common, November.
28	Leptodermis lanceolata	Padera ..	Very common, summer.
	Tribe Spermacoceæ		
29	Spermacoce articularis	...	Common.
30	„ lasiocarpa [stricta, Roxb.]	...	„
	Tribe Galiaceæ.		
31	Rubia cordifolia	Májethi	Common.
32	„ nervosa, Edgo.	. . ...	Rare; Gangoli bridge.
33	„ Munjista	...	Rare.
34	„ alata	...	„
35	Galium asperifolium	Kuri ...	Common.
36	„ elegans .	„ ...	„
37	„ Hamiltonii [G. latifolium, Don.]	„ ...	Frequent.
38	„ hirtiflorum [G. ciliatum, Don.]	„ ...	„ Binsar.
39	„ aparine . .	„ ..	Introduced
40	asperuloides, Edge., [tricorne, Dr. King.]	„ ...	Very common; above 10,000 feet.
	ORDER 3.—VALERIANEÆ		
1	Nardostachys grandiflora ..	...	Rare
2	Valeriana Wallichii ...	Shami ..	Frequent
3	„ Hardwickii [V. elata, Don.]	„ ...	Common.
4	„ tenera	„ ...	Frequent

DIVISION II.—MONOPETALÆ—(*continued*).

No.	Scientific name	Vernacular name	Note
	ORDER 4.—DIPSACEÆ		
1	Morina Wallichiana [brevi flora, Edgw ?]	...	Common.
2	„ longifolia	...	Above 10,000 feet.
3	Dipsacus strictus, Don.		China, 8,700 „
4	„ inermis	...	Very common.
5	„ levis?	Narao ...	Common
6	Scabiosa Candollii	...	„ May.
	ORDER 5.—COMPOSITÆ		
	TRIBE VERNONIACEÆ		
1	Vernonia (Stengelia) anthelmintica,	...	Rare; autumn
2	„ (Tephrodes) cinerea	Kálajira ...	Very common up to 8,000 feet
	„ „ var. montana	„ ...	Common
3	„ (Xipholepis) teres	...	Col. Davidson.
	TRIBE EUPATORIÆ		
4	Adenostemma viscosum, *var.* latifolium	...	Common up to 2,500 feet
5	Ageratum conyzoides	...	Autumn, common up to 6,000 feet
6	Eupatorium longicaule	...	October, common
	TRIBE ASTEROIDEÆ		
7	Solidago virga aurea [Amphiraphis pubescens, D. C.]	...	Summer, common.
8	Dichrocephala latifolia	...	„
9	Cyathocline lyrata	...	Common up to 4,000 feet.
10	Myriactis nepalensis [oleosa, Edgw.]		Autumn, common.
11	„ Wallichii [gracilis, Edgw.]	...	„
12	„ Gmelini	...	October, frequent.
13	Rhynchospermum verticillatum	...	Autumn; rare.
14	Callistephus chinensis	Naipala ...	Introduced
15	Aster (Euaster) amellus	...	Aug., above 8,000 feet
16	„ (Alpigenia) alpinus	...	July, above 11,000 feet.
17	„ (Orthomeris) molliusculus	...	May and June; frequent
18	„ „ altaicus	...	Aug., above 9,000 feet.
19	„ „ spartioides	...	„
20	„ (Calimeris) peduncularis	...	September, October, common
21	Erigeron canadense	Sallo ...	Introduced, but now very common.
22	„ acre [Roylei, D. C.]	Mirch múl ...	May, August; very common
23	„ multiradiatum	...	July, August; rare.
24	Microglossa cabulica [Aster ferrugineus, Edgw.]	...	Rare, Badrináth
25	Conyza veronicæfolia	...	September, common
26	„ viscidula [polycephala, Edgw.],		Feb., up to 4,000 feet
27	„ absinthifolia	...	Very common, autumn.

DIVISION II.—MONOPETALÆ—(*continued*).

No	Scientific name.	Vernacular name.	Note.
	ORDER 5.– COMPOSITÆ—(continued).		
	TRIBE INULOIDEÆ		
28	Blumea Wightiana	...	Spring ; Bhábar
29	„ lacera	..	„ very common
30	„ hieracifolia	.	May, common.
31	„ runcinata [laciniata, Roxb],	...	„ frequent
32	„ oxydonta .. .	...	„
33	Blumea densiflora	...	November ; Col. Davidson.
34	Laggera alata	Amdok ...	October , common.
35	Sphæranthus hirtus [mollis, Roxb],	..	Spring , „
36	Filago arvensis, *var*. lutescens ...	...	Common.
37	Leontopodium alpinum	.	Above 12,000 feet
38	Anaphalis cinnamonea	Jhula, bokla,	Autumn ; common
39	„ triplinervis . .	..	„ „
40	„ nubigena	...	„ above 9,000 feet
41	„ mucronata ...	...	„ above 12,000 feet
42	„ tenella [contorta, Don] ..	.	„ very common.
43	„ margaritacea	.	„ Col Davidson.
44	„ adnata	...	„ common.
45	„ araneosa . ..	..	„ „
	var semidecurrens .	.	„ very common.
46	Phagnalon niveum	..	June , banks of Dhauli near Niti pass.
47	Gnaphalium hypoleucum ...	...	Autumn ; very common.
48	„ luteo album ..	...	„ common
49	Cæsulia axillaris ..	..	October ; rice fields ; Gauni
50	Inula [Corvisartia] Royleana ..	..	Above 10,000 feet.
51	„ (Bubonium) vestita ..	..	Spring ; up to 3,000 feet.
52	„ nervosa [nitida, Edgw] ...	..	Autumn , frequent.
53	„ barbata . .	.	„ „
54	„ (Cappa) Cappa	Tamagari ..	November ; very common
55	„ cuspidata	...	October ; common.
56	„ rubicaulis ...	...	March ; frequent.
57	Vicoa indica . ..	..	Common
58	Carpesium cernuum *var*. nepalense ..	.	Autumn ; common.
	„ *var*. pedunculosum,	...	..
	„ *var* trachelifolium,	...	.
59	„ abrotanoides [racemosum, Wall].	..	Autumn , rare.
	TRIBE HELIANTHOIDEÆ		
60	Adenocaulon himalaicum ...	...	September ; rare.
61	Xanthium strumarium	...	Up to 5,000 feet.
62	Zinnia elegans	..	Naturalized.
63	„ multiflora	..	„
64	Seigesbeckia orientalis .. .	Gobariya ...	October ; very common.

DIVISION II.—MONOPETALÆ—(*continued*).

No	Scientific name.	Vernacular name.	Note.
	ORDER 5.—COMPOSITÆ—(continued).		
	Tribe Helianthoideæ—(concluded)		
65	Eclipta alba, *var* erecta	...	Common.
	,, ,, prostrata . .	..	,,
66	Blainvillea latifolia	Kaushaniya.	Very common
67	Wedelia biflora ? .	.	Rare
68	Coreopsis (Calliopsis) tinctoria .	...	Naturalized
69	Bidens (Platycarpæa) tripartita [repens, Don.]	. .	June, October ; common
70	,, (Psilocarpæa pilosa		Very common.
71	,, ,, decomposita,	.	,,
72	Glossogyne pinnatifida ...	.	Low elevations.
73	Chrysanthellum indicum . .	..	September; introduced.
74	Galinsoga parviflora .	...	,,
	Tribe Helenioideæ		
75	Tagetes patula	...	Gardens and naturalized
76	,, erecta .. .	.	,,
	Tribe Anthemideæ		
77	Achillea millefolium, *var* cuspidata, Wall.	...	Rare.
78	Allardia tridactylites ? ...	...	Above 15,000 feet.
79	,, tomentosa	..	Above 12,000 feet.
80	Cotula anthemoides ? .	. .	February ; rare.
81	Tanacetum longifolium	...	September, about 11,000 feet.
82	Artemisia (Dracunculus) scoparia ..	Jhao ..	October, common.
83	,, ,, parviflora...	..	,,
84	,, (Abrotanum) vestita	Deo pati ..	September, October ; rare, Jageswar
85	,, ,, vulgaris [indica, Roxb.]	Pati .	September, October ; very common.
	,, ,, *var.* hypoleuca, Edgw.	...	Common
86	,, (Absinthium) sieversiana,	...	About 12,000 feet, Jhelam.
	Tribe Senecionideæ.		
87	Tussilago farfara	...	Common; banks of streams above 10,000 feet
88	Doronicum Roylei [Fullartonia Kumaonensis, D.C.]	...	High elevations
89	Gynura nepalensis, *var.* Thomsoni ..	...	March, common, Ránibagh.
90	Emilia sonchifolia	...	Very common.
91	Senecio (Synotis) alatus.. ...	. .	October, November ; Pindari, China hill.
92	,, ,, densiflorus ..	...	October to April; very common.

DIVISION II.—MONOPETALÆ—(*continued*).

No	Scientific name	Vernacular name	Note
	ORDER 5.—COMPOSITÆ—(continued)		
	TRIBE SENECIONIDEÆ—(concluded)		
93	Senecio (Synotis) rufinervis	.	November, frequent.
94	„ „ Kunthianus	..	September, above 10,000 feet
95	„ „ Candolleanus	.	„ „
96	„ (Euseneclo) graciliflorus,	.	October, high levels
97	„ „ chrysanthemoides,	.	„ Pindari
98	„ „ pallens [violaceus, Wall]	Rat patiya .	March, June, very common
99	„ (Ligularia) sibiricus	.	September, Pindari
100	„ „ arnicoides	.	„ „
101	„ Cacalia) quinquelobus	..	Above 10,000 feet.
	TRIBE CYNAROIDEÆ		
102	Echinops niveus	Kanaila, jaokanda	Very common
103	Carduus nutans	.	Above 8,000 feet, Jhelam near Níti
104	Cnicus arvensis	..	Rare
105	„ eriophorus *var.* involucratus,	.	Autumn, common.
106	„ ferox, Edgw		May common
107	„ argyracanthus		June common
108	„ *var* nepalensis	.	October, common.
109	„ Wallichii (arachnoidea, Wall),	..	„ „
110	Saussurea (Bracteatæ) obvallata	..	September, above 10,000 feet.
111	„ (Acaules) Kunthiana	.	„ „
112	„ (Congestæ) gossypina (sacra, Edgw)	Kanwal .	September, common above 10,000 feet.
113	„ „ graminifolia	..	„ about 10,000 feet.
114	„ (Coarctatæ pterocaulon	..	„ about 10,000 feet
115	„ (Corymbosæ) candicans	.	Very common
116	„ „ *var.* scaposa	...	Common, April, Panwa Naula
117	„ „ albescens	..	September, frequent.
181	„ „ denticulata,		September, common
119	„ „ hypoleuca	.	„ „
120	Jurinea macrocephala (Dolomiæa macrocephala, D C)	Kálá tagar ..	„ „ Pindari.
121	Serratula pallida	...	May, June, very common
122	Tricholepis furcata	...	November, Pindari
123	„ elongata		October, common
124	Volutarella divaricata		March, Haldwáni
125	Carthamus tinctorius	Kusam ...	„ Cultivated, Bhábar
	TRIBE MUTISIACEÆ		
	SECTION SUBÆQUALIFLORÆ.		
126	Leucomeris spectabilis	.	May, common
127	Ainsliæa pteropoda	.	Spring, very common.
	„ aptera	...	„ „

DIVISION II.—MONOPETALÆ—(*continued*).

No	Scientific name.	Vernacular name	Note
	ORDER 5—COMPOSITÆ—(concluded)		
	SECTION LABIATÆFLORÆ		
128	Gerbera lanuginosa (Chaptalia gossypina, Royle)	...	June, high elevations
129	" nivea	..	September "
130	" macrophylla (Chaptalia maxima, Don)	...	" "
	TRIB. CICHORACEÆ.		
131	Cichorium intybus		Cultivated
132	Picris hieracioides	.	Manpat near Lohaghát, October.
132	Crepis (Barkhausia) fœtida		May, June, very common.
133	" (Youngia) lyrata [runcinata Wall]	.	Very common. An Lactuca ?
134	Taraxacum Dens leonis	..	Very common
.	" *var* eriopodium	...	" "
	" *var* parvulum	..	High elevations
135	Lactuca (Brachyramphus) obtusa	Jangli gobhi,	April, May, very common, yellow.
...	" [Microrhynchus nudicaulis and patens, D C]	..	
136	" (Scariola) scariola	.	Low elevations ; yellow
.	" " *var* sativa	.	Cultivated "
137	" (Cicerbita) auriculata	...	May, July, very common, blue.
138	" " longifolia	...	October, fields, common, blue
139	" (Lactucopsis sagittarioides,	...	February, common ; blue An Crepis ?
140	" " Brunoniana [Prenanthes Brunoniana, D C]	...	August, October, common, blue.
141	" (Melanoseris) hastata	.	Autumn, common, Lohba ; blue or white
142	" " lævigata [macrorhizon, Royle]	..	September, very common, blue
143	" " violæfolia	...	September, high elevations, blue.
144	" " Lessertiana	..	Common, October, blue
145	" " dubyæa [Dubyæa hispida, D C]	..	September, very common ; yellow
146	" (Ixeris) glabra	...	Winter, low elevations, yellow
147	" " polycephala	.	" "
148	Prenanthes hispidula	.	Rare
149	Sonchus asper	Ufat kanela nalsha.	Spring, very common.
150	" oleraceus	"	Spring, common, edible
151	" arvensis	"	Spring, common.
152	Michrorhynchus secundus	..	Rare, Royle.
153	Tragopogon junceum	...	June, July, very common.

DIVISION II.—MONOPETALÆ—(*continued*).

No	Scientific name.	Vernacular name.	Note
	ORDER 6.—LOBELIACEÆ		
1	Lobelia trigona, Roxb., [trialata, Don.]	..	Common.
2	„ pyramidalis, Wall ..	..	Frequent
3	„ rosea, Wall ..	..	Rare, Malwa Tál.
	ORDER 7.—CAMPANULACEÆ.		
1	Cephalostigma hirsuta ..	Gol ghanna,	Frequent
2	Wahlenbergia viridis, Edgw	..	Wácham, near Pindari
3	„ agrestis ..	...	Frequent, Banks of Kosi
4	Campanula latifolia ..	...	Rare.
5	„ sylvatica [integerrima Don]	...	Common under trees
6	„ canescens ..	..	Very common
7	„ argyrotricha [pallida, Madden]	..	„
8	„ colorata ramulosa, Wall]	...	Rare
	ORDER 8.— ERICACEÆ.		
1	Gaultheria nummularia ..	Bhalu bor ..	Common, Dákuri, Bhatkot
2	„ trichophylla ..	..	Frequent, above 10,000 feet.
3	Andromeda (Pieris) ovalifolia, [A. capricida,' Don.]	Aiyár ..	Very common.
4	„ (Cassiope fastigiata [A cupressiformis, Wall]	Kamba ..	Milam and Pindari, 12,000 feet.
5	Rhododendron arboreum ..	Buráns ..	Very common.
	„ *var.* roseum	..	Above 8,000 feet.
6	„ campanulatum ..	Chimul ..	„ 10,000 „
7	„ anthopogon ...	Talistár ..	„ 12,000 „
8	„ lepidotum ...	..	„ 12,000 „
	ORDER MONOTROPEÆ.		
1	Monotropa nepalensis ..	Chháo ..	Binsar, September; found by Mrs Govan
	ORDER 10.—LENTIBULARIÆ		
1	Utricularia flexuosa [stellaris, Wight]	..	Common.
2	Pinguicula alpina ..	..	Rare
	ORDER 11. PRIMULACEÆ		
1	Primula (Sphondylia) floribunda ..		Down to 2,500 feet.
2	„ (Primulastrum) petiolaris [nana, Wall] ..		Above to 10,000 feet.
3	„ (Athritica) purpurea ...	...	„

DIVISION II.—MONOPETALÆ—(*continued*).

No	Scientific name	Vernacular name	Note.
	ORDER 11.—PRIMULACEÆ—(concluded).		
4	Primula Stuartii		...
5	„ (Auriculastrum) speciosa	Bish kopra	Common
6	„ involucrata		Above 10,000 feet
7	„ denticulata, *var.* erosa	...	Common, high elevations
8	Androsace sarmentosa, Wall	..	„
9	„ lanuginosa, Wall		Above 12,000 feet.
10	„ rotundifolia, Hardw		Common
11	„ incisa Wall, [rotundifolia, Don]		Valleys and Bhábar, winter and spring
12	Lysimachia (Ephemerum) lobelioides,		Very common above 10,000 feet.
13	„ pyramidalis		Common
14	„ (Lysimastrum) alternifolia		„
15	„ debilis		„
16	Anagallis arvensis, *var.* cœrulea	Jonk-mara	„
17	Samolus Valerandii		Rare, Suál river.
	ORDER 12.—MYRSINACEÆ.		
1	Mæsa (Bæobotrys) indica	Kalsís ...	Common. Low elevations
2	„ argentea	Phusera	Frequent, Binsar.
3	Myrsine africana	Pahári chá, baiberang,	Common, March.
4	„ semiserrata	Chupra ...	„
5	„ acuminata	„	„
6	Embelia robusta	Baiberang	Bhábar
7	Ardisia floribunda		Rare
	ORDER 13.—SAPOTACEÆ.		
1	Bassia butyracea	Chiúrá and phalel	Common at 4,000 feet, near Petoragarh
2	„ latifolia	Mahúa	Bhábar.
	ORDER 14.—EBENACEÆ.		
1	Diospyros Melanoxylon	Tendu	Bhábar
2	„ montana	Tendu	„
3	„ lanceæfolia	Ardinia	Kota Dún
4	„ Embryopteris	Gab ...	Bhábar
	ORDER 15.—SYMPLOCEÆ.		
1	Symplocos (Hopea) spicata	Lodh, bholya,	Barmdeo, November
2	„ sumuntia		Rare, Siáhi devi
3	„ racemosa		Bhábar, November
4	„ ramosissima [nervosa, Madden]	...	Rare, Gágar, Binsar May
5	„ (Palura) cratægoides [S paniculata, Madden]	Lodh	Very common, June and July

DIVISION II.—MONOPETALÆ—(*continued*).

No	Scientific name.	Vernacular name	Note.
	ORDER 16.—OLEACEÆ		
1	Fraxinus excelsior . .	Angu ..	Common.
2	" *(Ornus) floribunda*	Angu	Common
3	Syringa emodi ..	Glua .	Common, above 10,000 feet.
4	Olea cuspidata [ferruginea, Royle Ill.]	Kalap briksh,	Patál debi near Almora
5	" acuminata *var.* longifolia	Silang .	Very common, wild and planted.
6	" glandulifera ...	Gaur ..	Common
7	Ligustrum nepalense ..	.	Banks of streams, May,
8	" bracteatum .. .	..	Frequent, Binsar, June
9	" robustum ..	.	Common, May
10	" compactum	..	"
	ORDER 17.—JASMINEÆ		
1	Jasminum (Simplicifoliæ) Sambac	..	Cultivated.
2	" pubescens	.	Frequent, Ganai
3	" arborescens .		" Bhábar
4	" nepalense [dichotomum Don]	Jáhi .	Common
5	" (trifoliæ) dispermum	Surmáli. ...	Common. Leaves, generally trefoil, but sometimes simple and sometimes pinnate
6	Jasminum (Alternifoliæ) revolutum [chrysanthemum, Roxb.]	Sonajahi ...	Common.
7	" " pubigerum ..	.	Rare.
8	" (Pinnatifoliæ) officinale,	Chambelí . .	Introduced.
9	" " grandiflorum,	Chambeli and jáhi.	Common.
10	Nyctanthes Arbor-tristis ...	Pariját, harsinghár of plains	
11	Schrebera swietenoides	Moka ..	Bhábar tree.
	ORDER 18.—APOCYNACEÆ		
	TRIBE CARISSEÆ.		
1	Carissa diffusa . . .	Timukiya ..	Bhábar.
	TRIBE PLUMERIEÆ.		
2	Tabernæmontana coronaria .	Chandi . .	"
3	Vinca pusilla [V. parviflora, Roxb.]	..	"
	TRIBE PARSONSIEÆ.		
4	Vallaris dichotoma	Dúdhi ...	Common.
	TRIBE WRIGHTIEÆ.		
5	Wrightia mollissima	Dauhela ...	"

DIVISION II.—MONOPETALÆ—(*continued*).

No.	Scientific name.	Vernacular name.	Note.
	ORDER 18.—APOCYNACEÆ—(concluded).		
	Tribe Alstonieæ.		
6	Alstonia scholaris . . .	...	Bhábar
7	Blabcæpus lucidus .	Dúdhi .	Common
	Tribe Echiteæ.		
8	Holarrhena antidysenterica	Kuer ..	„
9	„ pubescens . ..	.	„
10	Nerium odorum	Kanyúr . .	
11	Chonemorpha macrophylla, [Echites macrophylla, Roxb.]	Garbadru ..	Bhábar
12	Ichnocarpus frutescens	Dúdhi .	Common.
	ORDER 19.—ASCLEPIADEÆ.		
	Tribe Periploceæ.		
1	Cryptolepis reticulata .	Rui kosa .	Up to 4,000 feet.
2	Periploca calophylla [Streptocaulon calophyllum, Wright.]	Dál bhengla,	Common
	Tribe Asclepiadeæ.		
3	Vincetoxicum canescens [Cynanchum glaucum, Wall.]	..	Common
4	„ montanum [V. kumaonense, Madden.]	...	Frequent.
5	Calotropis gigantea	Ak, madár .	Common, Bhábar.
6	„ procera [Hamiltonii] .	„ . .	Rare, Bhabar.
7	Cynanchum Dalhousiæ . . .	...	Frequent.
	Tribe Stapelieæ.		
	Sub-tribe Pergularieæ.		
8	Tylophora tenerrima . . .	.	Frequent.
9	„ Govanii [Iphisia Govaniana, Wight.]	.	. .
10	Marsdenia Roylei ...	Murkila ..	Common
11	„ lucida, Edgw ..	Dúdhi ...	Frequent.
12	„ tenacissima .	.	Up to 4,000 feet
13	Pergularia pallida . . .	Súrkila ..	Common, Bhábar.
14	Gongronema nepalense .	.	Frequent on rocks.
	Sub-tribe Ceropegieæ.		
15	Orthanthera viminea . .	Chapkiya ...	Bhábar.
16	Hoya lanceolata	...	Common, Bhábar, and up to 7,000 feet.
17	Ceropegia longifolia . .	.	Rare
18	„ Wallichii . . .		Frequent.
19	„ gracilis, Edgw.		„

DIVISION II.—MONOPETALÆ—(*continued*).

No.	Scientific name	Vernacular name	Note
	ORDER 20.—LOGANIACEÆ.		
1	Gardneria ovata	Banjáhi	Frequent
2	„ angustifolia		„
3	Buddleia crispa [paniculata, Roxb.]	Dhiriya, bháti, dhaula.	Common.
4	„ asiatica [neema, Hamilton],	...	„
	ORDER 21.—GENTIANACEÆ.		
	TRIBE CHIRONIEÆ.		
1	Exacum tetragonum	Uda, titkána,	Frequent, Bageswar
	TRIBE CHLORÆ.		
2	Pladera pusilla	...	Common.
3	Canscora diffusa [virgata, Roxb.]	.	Bhábar.
4	„ decussata	..	„
	TRIBE SWERTIEÆ		
5	Gentiana (Chondrophyllum) pedicillata	...	Common.
6	„ capitata	...	„
7	„ aprica	...	Bhábar.
8	„ decemfida	...	Common.
9	„ marginata	...	„
10	Ophelia paniculata	Chiretta Titkána.	Autumn annual.
11	„ purpurescens	„	„ „
12	„ cordata	„	„ „
13	„ *var* floribus dilute roseis	..	W. Waterfield, Naini Tál.
14	„ (Agathotes) angustifolia	„	Autumn annual.
15	„ „ chirata	„	„ perennial.
16	„ „ alata	„	„ annual
17	Halenia elliptica	..	Above 10,000 feet.
18	Swertia cuneata	..	Rare
19	„ cærulea		„
20	„ speciosa [perfoliata, Royle],	Simariya	Common, above 10,000 feet.
	ORDER 22.—BIGNONIACEÆ.		
1	Calosanthes indica	Pharkath	Bhábar
2	Millingtonia hortensis [Bignonia suberosa, Roxb.].	Nim chambeli	Introduced
3	Stereospermum [Bignonia, Roxb.] suaveolens	Pátal	Bhábar.
4	Amphicome arguta	.	Banks of Patálganga.
5	Tecoma undulata	...	Ganai valley. May.

DIVISION II.—MONOPETALÆ—(*continued*).

No	Scientific name.	Vernacular name	Note.
	ORDER 23.—PEDALIACEÆ		
1	Martynia proboscidea [M. diandra, Madden]	..	Naturalized.
2	Sesamum indicum .	Til ..	"
3	Pedalium murex. . .	Gokhru .	Bhábar
	ORDER 24.—CRYTANDRACEÆ		
1	Lysionotus ternifolia [L. serrata, Don].	..	Common up to 4,000 feet
2	Didymocarpus subalternans .	..	Rare
3	" aromatica ..		Frequent
4	" (Acaules) macrophylla .	Pathar laung,	Common.
5	" pedicellata .	.	Bhábar.
6	" lanuginosa .	.	Common
7	Chirita Edgeworthii	Sankh pushpa,	"
8	" bifolia	"	"
9	Rhynchoglossum obliquum [Wulfenia obliqua, Wall]	..	" up to 6,000 feet
10	Platystemma violoides .. .	.	Common.
11	Æschynanthus Perottetiana	..	Bhábar.
12	" grandiflorus ..	...	Har silang. October.
13	Polyneuron dimidiata . ..	...	Col Davidson
	ORDER 25.—POLEMONIACEÆ		
1	Cyananthus lobata . .	...	Pindari, above 10,000 feet
2	" integra	...	Kedár 12,000 feet.
	ORDER 26.—CONVOLVULACEÆ		
	TRIBE ARGYREIEÆ.		
1	Rivea ornata	.	Bhábar
2	Argyreia speciosa	.	"
3	" setosa	..	Sarju, bank near Kapkot, September.
4	" capitata	...	..
	TRIBE CONVOLVULEÆ.		
5	Quamoclit vulgaris	...	Bhábar
6	Batatas pentaphylla . ..	...	"
7	Pharbitis Nil .. .	Baunra ...	Very common
	var. integrifolia [cærulea, Roxb.] . .	" ...	Common
8	Calonyction speciosum .	.	Bhábar
9	Ipomœa vitifolia	...	"
10	" Pes-tigridis ..	...	"
11	" Pilosa ..	..	Kota Dún.
12	" *sp* [hirsuta, Madden] ...	..	"

DIVISION II.—MONOPETALÆ—(*continued*).

No	Scientific name.	Vernacular name	Note.
	ORDER 26.—CONVOLULACEÆ—(concluded).		
	TRIBE CONVOLVULEÆ—*(concluded)*.		
13	Ipomœa sessiliflora [phæocephalus, Roxb]	...	Very common.
14	„ chryseides [muricata, Madden]	...	Bhábar.
15	Aniseia barlerioides .	...	Kosi bank, Khairna.
16	Convolvulus pluricaulis .	...	Bhábar.
17	„ arvensis [Malcolmi Roxb]	..	Naini Tál, Mr Waterfield
18	Porana racemosa .	Maseti ✓ .	Common.
19	„ paniculata	„ ..	„
20	Evolvulus alsinoides [sericea, Madden],	...	Very common.
	TRIBE CUSCUTEÆ		
21	Cuscuta reflexa [verrucosa] .	Akash leguli, ✓	Common.
22	„ macrantha [grandiflora, Wall]	„ ...	Frequent
	ORDER 27.—BORAGINACEÆ		
	TRIBE CORDIEÆ.		
1	Gynaion vestitum . .	Pyú .	Common up to 3,000 ft.
2	Cordia latifolia, Roxb .	Borla	Bhábar variety
3	„ Myxa, Linn	Kodah .	Common
	TRIBE EHRETIEÆ		
4	Ehretia serrata	Pánya .	Common, April
5	„ lævis .	Kodah ..	„ Bhábar, March.
6	„ viminea [Rhabdia sericea ... Madden].	..	„ in river beds.
	TRIBE HELIOTROPEÆ		
7	Heliotropium strigosum [brevifolium Wall]	...	Common.
	TRIBE BORAGEÆ		
	SUB-TRIBE ECHIEÆ		
8	Macrotomia Benthami	..	Badrináth.
	SUB-TRIBE LITHOSPERMEÆ		
9	Onosma echioides	...	Above 10,000 feet.
10	Myosotis pallens	...	„ „ Chaupatta.
11	„ longiflora . .	..	„ „ „
12	Bothriospermum tenellum [Cynoglossum prostratum, Don].	...	Rare, Binsar.

DIVISION II.—MONOPETALÆ—(*continued*).

No.	Scientific name.	Vernacular name.	Note
	ORDER 27.—BORAGINACEÆ—(concluded).		
	SUB-TRIBE CYNOGLOSSEÆ.		
13	Eritrichium rotundifolium	...	Above 10,000 feet; rare.
14	Echinospermum glochidiatum [Cynoglossum uncinatum, Royle]	Kura	,, ,, ,,
15	Cynoglossum furcatum	,,	Very common.
16	,, micranthum [canescens, Wall]	,,	,, ,,
17	,, glochidiatum	,,	Frequent
18	Trichodesma indicum	...	Common.
	ORDER 28.—SOLANACEÆ		
	TRIBE SOLANEÆ		
1	Lycopersicum esculentum	Wiláyati baigan.	Cultivated
2	Solanum (Pachystemon) tuberosum	Alu	,,
3	,, Roxburghii [rubrum]	Chhota ghiwain.	Common.
4	,, verbascifolium	Ushita	,,
5	,, (Leptostemon) indicum	Kant kári	,,
6	,, xanthocarpum	...	
	,, *var.* Jacquinii	...	,,
	,, *var* Schraderi [diffusum]	.	,,
7	,, esculentum [melongena],	Baigan	Cultivated.
8	Capsicum frutescens	Lál mirch	,,
9	Nicandra physaloides	.	Introduced.
10	Physalis peruviana	...	,,
	TRIBE DATUREÆ.		
11	Datura Wallichii [ferox, Madden]	Kála dhatúra,	Valleys
	,, *var.* double	.	Cultivated
12	,, alba	Dhatúra	Very common.
	,, *var.* double	...	Cultivated.
	TRIBE NICOTIANEÆ.		
13	Nicotiana Tabacum	Tamáku	Cultivated
14	Petunia Phœnicea	..	Introduced.
	ORDER 29.—SCROPHULARIACEÆ.		
	TRIBE ANTIRRHINIEÆ.		
1	Verbascum Thapsus	Ekalbir	Common
2	Celsia coromandeliana	.	Rare, valleys.
3	Linaria ramosissima	...	Common
4	,, incana	.	,,
5	Antirrhinum orontium	..	,, May fields.
6	Scrophularia Edgeworthii	..	Above 12,000 feet

DIVISION II.—MONOPETALÆ—(*continued*).

No	Scientific name.	Vernacular name	Note.
	ORDER 29.—SCROPHULARIACEÆ—(continued)		
	TRIBE ANTIRRHINEÆ—(concluded)		
7	Scrophularia polyantha	Gajaila	Common
8	,, himalensis	,,	,,
9	,, obtusa (Madden)	,,	Frequent
10	Mimulus nepalensis	...	Common
11	,, gracilis	..	Frequent
12	Mazus surculosus		Common.
13	,, rugosus	..	,,
14	Lindenbergia grandiflora	.	,,
15	,, urticæfolia [Stemodia ruderalis, Wall]	...	Very common.
16	,, macrostachya		Rare
17	Limnophila menthastrum	Janglı sonf	Common
18	,, hypericifolia	,,	,,
19	Herpestis Monnieria	Jál ním	,,
20	Torenia cordifolia	..	,,
21	Vandellia crustacea [pedunculata, Madden]	.	,,
22	,, nummularifolia	..	Very common August.
23	Bonnaya brachiata	..	Frequent September.
24	,, grandiflora	...	,,
	TRIBE RHINANTHEÆ		
25	Hemiphragma heterophyllum	...	Common at 10,000 feet, Dákuri and Dyúritál
26	*Digitalis purpurea*	...	*Introduced.*
27	Wulfenia Amherstiana [Pæderota Amherstiana, Wall]	...	Common near water above 8,000 feet.
28	Veronica (Beccabunga) himalensis [grandiflora, Wall].	..	Above 10,000 feet
29	,, anagallis	.	Up to 5,000 feet.
30	,, punctata	.	,,
31	,, (Chamædrys) deltigera	..	Common
32	,, ,, laxa	..	Above 11,000 feet.
	,, *var.* of V. chamædrys?	...	Kedarnáth.
33	,, (Omphalospora) biloba	.	Common at 5,000 feet. March
34	,, ,, Maddeni Edge.	.	,,
35	,, ,, agrestis	.	,,
36	Buchnera hispida	.	,,
37	Striga hirsuta	.	,,
.	,, *var.* lutea	..	
38	,, euphrasioides	..	,,
39	Leptorhabdos parviflora [Gerardia and Sopubia parviflora]	.	,,
40	Sopubia trifida	...	Grassy slopes at 6,000 feet.
41	Centranthera hispida	...	Bageswar. Frequent.
..	,, *var.* nepalensis		
42	Euphrasia officinalis	..	Above 7,000 feet.

DIVISION II.—MONOPETALÆ—(*continued*).

No	Scientific name	Vernacular name	Note.
	ORDER 29.—SCROPHULARIACEÆ—(concluded)		
	TRIBE RHINANTHEÆ—(concluded).		
43	Pedicularis (Cyclophyllum) pectinata	...	Frequent.
44	,, ,, porrecta,	..	,,
	,, [elegans, Madden] .	..	,,
45	,, (Siphonatus) megalantha	.	Above 10,000 feet.
46	,, (Edentulæ) carnosa . .	...	Common.
	ORDER 30.—OROBANCHEACEÆ		
1	Phelipæa ægyptiaca .	. .	Rare
2	Æginetia indica .	. .	Frequent, Bageswar.
	ORDER 31.—ACANTHACEÆ		
	TRIBE THUNBERGIEÆ.		
1	Hexacentris coccinea ..	Kaljug ...	Bhábar and valleys. Winter
	TRIBE HYGROPHILEÆ.		
2	Hemiadelphus polysperma .	...	Bhábar
	TRIBE RUELLIEÆ.		
3	Petalidium barlerioides .	Bakraola .	,,
4	Hemigraphis latebrosa, [Ruellia latebrosa]	..	Common
5	Æchmanthera Wallichii [gossypina, Madden]	Jaundela ...	Very common. From this bees make the best honey
6	Goldfussia pentstemonoides .	.	Frequent.
7	Strobilanthes auriculatus .	Tilkapuri ..	Bhábar
8	,, Wallichii .	.	Above 10,000 feet.
9	,, attenuatus ..	Kapur nali ..	Common.
10	,, glutinosus ...	.	,,
	TRIBE BARLERIEÆ.		
11	Barleria dichotoma .	.	Frequent, September.
12	,, nepalensis	.	,,
13	,, ciliata (rosea) ...	Sarp jiba ...	Common
14	,, cristata ..	..	,,
15	Lepidagathis hyalina		,,
16	,, ustulata	...	About 4,000 feet.
17	,, cuspidata	..	Common

DIVISION II.—MONOPETALÆ—(*continued*).

No.	Scientific name	Vernacular name	Note.
	ORDER 31.—ACANTHACEÆ—(concluded)		
	TRIBE JUSTICIEÆ.		
18	Phlogacanthus thyrsiflorus	.	Bhábar and valleys common March
19	Eranthemum nervosum .	..	Bhábar and up to 6,000 feet. May,
20	Rostellularia procumbens .		Very common
21	Adhatoda vasica [Justicia Adhatoda],	Bashang Arus of plains	Common
22	Rungia parviflora ..	.	,,
23	Dicliptera Roxburghii	.	,,
			,, up to 5,000 feet.
24	Peristrophe speciosa .	.	
25	,, bicalyculata	.	Bhábar
26	Rhaphidospora ciliata .	.	Rare, Vishnuganga
	ORDER 32.—PHRYMACEÆ		
1	Phryma leptostachya .	.	Common in woods
	ORDER 33.—VERBENACEÆ		
	TRIBE VERBENEÆ.		
1	Verbena Bonariensis ...	.	Naturalized.
2	,, officinalis	..	Common.
3	Lippia (Zapania) nodiflora .		Up to 4,500 feet.
4	Lantana alba [L. dubia, Royle Ill.]	.	,, 3,500 ,,
5	Gmelina arborea .	Kumár .	,, 2,000 ,,
	TRIBE VITEÆ		
6	Caryopteris Wallichiana [Clerodendron odoratum, Madden]	Mohini ...	Very common up to 6,000 feet. April,
7	Premna (Gumira) serratifolia [spinosa, Roxb.]	.	Bhábar
8	,, (Premnos) mucronata ..	Agnián ...	,,
9	,, ,, barbata ..	.	Common
10	,, ,, herbacea ...	..	Rare.
11	Callicarpa arborea, Roxb. .	Ghiwáli .	Common
12	,, macrophylla, Vahl .	Daiya ..	Frequent, Sarju bank.
13	Clerodendron serratum ...	...	Common
	,, var. ternifolium	.	,, Bageswar.
14	,, infortunatum ..	.	,,
15	,, siphonanthus .		Bhábar.
16	Vitex negundo .	Shiwáli .	Bhábar and outer hills, April.
17	Holmskioldia sanguinea ..	Kubtoliya .	Common, October.
	ORDER 34.—LABIATÆ		
	TRIBE OCIMEÆ.		
1	Geniosporum strobiliferum ..	.	Banks of Sarju.
2	Orthosiphon rubicundus .	..	Common
3	,, virgatus .	..	Banks of Kosi.
4	Plectranthus (Isodon) scrophularioides,	.	Frequent.
5	,, ,, Gerardianus	..	,,
6	,, ,, striatus .	...	Very common October.

DIVISION II.—MONOPETALÆ—(*continued*).

No	Scientific name	Vernacular name	Note.
	ORDER 34.—LABIATÆ.—(continued).		
	TRIBE OCIMEÆ—(concluded)		
7	Plectranthus (Isodon) Coetsa	.	Very common Octr.
8	„ „ rugosus	..	Common up to 6,500 ft
9	„ (Pyramidium) ternifolius,	.	„ low elevations
10	„ (Coleoides) cordifolius	.	„
11	Coleus barbatus	Fiwai ..	Very common
	TRIBE SATUREIÆ		
	SUB-TRIBE ELSHOLTZIEÆ.		
12	Pogostemon plectranthoides	Rudra ..	Common
13	Dysophylla cruciata	.	„ in swamps.
14	Colebrookia oppositifolia	Dulshat ..	„
15	Elsholtzia flava	Bhangria	„ down to 5,000 feet.
16	„ polystachya	Bhangria .	Very common
17	„ incisa	Set bhangria	Rare
18	Elsholtzia pilosa	.	Frequent
19	„ eriostachya	.	Rare.
20	„ (Cyclostegia) strobilifera	.	Common
	SUB-TRIBE MENTHEÆ		
21	Perilla ocimoides	Bhangria ...	Cultivated, September.
22	Mentha viridis	Pudina ...	Naturalized.
23	„ Royleana	...	Rare. Near Bhím Tál
	SUB-TRIBE THYMEÆ		
24	Origanum normale? [vulgare?]	Ban tulsi ...	Very common, autumn.
25	Thymus serpyllum	„ ajwáin .	Common, except outer range
	SUB-TRIBE MELISSEÆ		
26	Micromeria biflora	.	Very common.
27	Calamintha (Clinopodium) repens	...	„
28	„ „ [Melissa, Madden] umbrosa	...	June, under trees.
29	Hedeoma nepalensis	...	Frequent
	TRIBE MONARDEÆ.		
30	Salvia (Drymosphace) glutinosa [hians, Royle.]	..	Frequent, outer range.
31	Salvia (Aethiopis) lanata	Ganiva .	Very common, March.
32	„ „ Moorcroftiana	.	Above 10,000 feet
33	„ (Notiosphace) plebeia	.	Bhábar and valleys
	TRIBE NEPETEÆ		
34	Nepeta (Pycnonepeta) spicata, *var*	.	Common, Binsar
	„ „ elata, Royle	..	Yellow, morning, blue afternoon
35	„ „ elliptica	..	Common, Binsar.
36	„ (Cataria) ruderalis	..	Frequent
37	„ „ leucophylla	...	Common
38	„ „ graciliflora	.	Bhábar
39	„ (Macronepeta) Govaniana		Frequent.
40	Dracocephalum acanthoides		Níti
41	Lallemantia Royleana	Bálangu ..	Rare.

DIVISION II.—MONOPETALÆ—(*concluded*).

No	Scientific name	Vernacular name	Note
	ORDER 34.—LABIATÆ.—(concluded)		
	TRIBE STACHYDEÆ		
	SUB-TRIBE SCUTELLARIEÆ.		
42	Prunella vulgaris	...	Common, June, Binsar.
43	Scutellaria linearis	.	„ spring
44	„ repens	...	„ spring and autumn
45	„ angulosa [scandens, Don]	...	„ autumn.
	SUB-TRIBE MARRUBIEÆ		
46	Craniotome versicolor	..	Very common.
	SUB-TRIBE LAMIEÆ		
47	Anisomeles ovata		Common
48	Colquhounia coccinea [vestita, Wall]	Bhilmora and angliriya	„ at Naini Tál and Badrináth.
49	Stachys sericea		Common
50	„ splendens	Bhainsia ajwáin.	Rare
51	Leonurus pubescens	..	Common.
52	Lamium amplexicaule	.	„
53	„ petiolatum	Tit páti ..	„
54	Roylea elegans	Guma ..	Frequent.
55	Leucas [Hemistoma] urticæfolia	.	„
56	„ [Ortholeucas] lanata	.	Common
57	„ „ mollissima	...	Rare
58	„ [Plagiostoma] hyssopifolia,	..	Common.
59	„ „ aspera [cephalotes, Blume.]	...	„
60	Leonotis nepetæfolia		Bhábar & Haldwáni.
61	Phlomis lamiifolia	..	Rare
	TRIBE AJUGEÆ		
62	Teucrium Royleanum (*var.*) albidum		Common, valleys
63	„ quadrifarium		„
64	Ajuga lobata	.	Bhábar.
65	„ remota	.	Very common.
66	„ parviflora	.	High elevations.
67	„ bracteosa	..	Very common
68	„ decumbens	..	Rare.
	ORDER 35.—PLUMBAGINACEÆ		
69	Plumbago Zeylanica	..	Common
	ORDER 36.—PLANTAGINACEÆ.		
1	Plantago (Polyneuron) major, *var.* asiatica.	Bár tang ...	Rare.
2	„ „ erosa, Don, [longiscapa, Jaeg.]	Lohuiya ...	Very common.
3	„ „ lanceolata.	...	Rare.

DIVISION III.—APETALÆ.

No	Scientific name	Vernacular name.	Note
	ORDER 1.—PHYTOLACCACEÆ		
1	Phytolacca, decandra, *var* acinosa,	Jirrag ..	Cultivated up to 10,000 feet.
	ORDER 2.—CHENOPODIACEÆ		
1	Beta vulgaris, *var.* Bengalensis, Roxb ,	Palang ..	Cultivated
2	Chenopodium album	Bhatuwa ..	Common.
3	„ (Ambrina) Botrys	...	„
	ORDER 3.—AMARANTACEÆ		
	TRIBE CELOSIEÆ.		
1	Deeringia celosioides ...	Kála lohári	Common.
2	Celosia argentea ..	Sirali and ghogiya	„
	TRIBE ACHYRANTHEÆ.		
3	Amarantus caudatus		Gardens
4	„ anardana [farinaceus]	Ramdána and chua	Cultivation
5	„ spinosus		Common
6	Ærua scandens	Sáji ...	„
7	Achyranthes aspera.		
8	„ species [bidentata ?], ..		*Not known at Kew*
9	Cyathula tomentosa [Pupalia sequax,] Madden	Jhat kuri ...	Very common
10	„ capitata		Rare.
	TRIBE GOMPHRENEÆ		
11	Alternanthera nodiflora ...	Bhímráj	Common, Bhím Tál.
	ORDER 4.—NYCTAGINACEÆ.		
1	Bœrhaavia diffusa ...		Common
2	Mirabilis Jalapa ..		Introduced.
	ORDER 5.—POLYGONACEÆ.		
	TRIBE PTERYGOCARPEÆ		
1	Rheum emodi	Dolu	Above 10,000 feet
2	Oxyria elatior		„ 9,000 „
	TRIBE APTEROCARPEÆ.		
3	Rumex (Lapathum) Wallichii ..	..	Bhábar
4	„ nepalensis	Haluniya ..	Common
5	„ (Acetosa) hastatus ..	Almora	Very common.
6	Kœnigia monandra or islandica ..		Above 12,000 feet.
7	Polygonum (Avicularia) effusum [herniarioides]	..	Common.
8	„ Roxburghii		Rare.
9	„ illecebroides	..	„

DIVISION III.—APETALÆ—(*continued*).

No.	Scientific name.	Vernacular name	Note
	ORDER 5.—POLYGONACEÆ—(concluded).		
	TRIBE APTEROCARPEÆ (concluded).		
10	Polygonum ciliosum . . .	...	Rare
11	" cognatum	...	14,500 feet
12	" recumbens .	.	Common. September
13	" (Persicaria) Hamiltonii [hispidum, Don],	.	Frequent, Bhábar, November
14	" barbatum . ..	..	Bhábar Common.
15	" Donii . .	..	Frequent.
16	" Posumbu	.	Bhábar.
17	" flaccidum [glabrum, Roxb.],	..	"
28	" amphibium . .	..	Naini Tál lake.
19	" lanigerum ...	.	Frequent
20	" scabrinervum .	.	Naini Tál lake
21	" (Bistorta) viviparum [bulbiferum, Royle].	..	15,000 feet
22	" sphærostachyum ..	.	Very common
23	" amplexicaule .	...	Common.
24	" affine [Brunonis, Wall.],		At high elevations.
25	" emodi .	...	Rare.
26	(Didymocephalon) delicatulum ..	...	12,000 feet
27	" nummularifolium,	.	14,500 feet
28	" filicaule [ciliatum, Don].	.	Rare
29	" humile .	.	"
30	" perforatum [punctatum, Don]	..	"
31	" nepalense . .		Common
32	" sphærocephalum,	.	Frequent.
33	" capitatum [repens, Wall.],	. .	Very common
34	" sinuatum .	. .	8,500 feet
	" (Corymbocephalon) chinense,	.	Very common
35	" (Echinocaulon) horridum ..	.	Bhím Tál
36	" (Tiniaria) convolvulus	..	Common
37	" pterocarpum .	...	"
38	" (Aconogonon) frondosum ..	.	7,500 feet.
39	" polystachyum . .	...	12,000 feet
40	" Fagopyrum esculentum [vulgare, Madden]	Ogal ...	Cultivated, lower hills.
41	" emarginatum .	Pápar .	Higher hills.
42	" cymosum [corymbosum, Madden]	Ban-ogal	Common. The native names given by Royle are incorrect.
	ORDER 6.—LAURINEÆ.		
	SECTION EXINVOLUCRATÆ.		
1	Cinnamomum Tamala, *var.* albiflorum	Tejpát, dálchini	Common. February—May
2	Phœbe lanceolata	San kanwal.	Bhábar and valleys, February—May.
3	" pallida . .	Kanwal .	Common.
4	" paniculata . . .	Kapan kanwal,	Bhábar and valleys.
5	Machilus odoratissimus	.	Common. March—August.

DIVISION III.—APETALÆ—(*continued*).

No.	Scientific name.	Vernacular name	Note.
	ORDER 6 —LAURINEÆ—(concluded)		
	SECTION INVOLUCRATÆ		
7	Tetranthera lanifolia [apetala, Roxb., *var* Roxburghii].	Gar-bijur ..	Valleys. June
8	,, monopetala .	Katmain, singrao	Common April.
9	Litsæa lanuginosa .	.	Rare
10	,, consimilis [T pallens, Don],	Chirira and chichira.	Common, interior of hills
11	Daphnidium pulcherrimum	.	Frequent
	,, bifarium	..	,,
	ORDER 7 —THYMELACEÆ		
1	Daphne papyracea [D cannabina, Wall],	.	Common.
	,, *var*. purpurea .	Baruwa .	
	,, ,, alba ..	Set baruwa	Used, for paper-making.
2	Wikstrœmia salicifolia [Daphne sericea, Madden]	Chamliya	Common, used for making inferior paper.
	ORDER 8.—ELÆAGNACEÆ.		
1	Hippophae salicifolia . ..	Dur chuk ...	Common above 10,000. feet
2	Elæagnus parvifolia .. .	Ghiwain ...	Common.
3	,, latifolia [ferruginea, D.C]		Bhábar
	ORDER 9 — SANTALACEÆ		
1	Osyris arborea, [nepalensis, Madden],	Bákar dhárá,	Common
2	Thesium himalense .	.	Rare, Binsar
	ORDER 10 —ARISTOLOCHIACEÆ		
1	Aristolochia saccata .	..	Frequent, about 7,000 feet
	ORDER 11 —EUPHORBIACEÆ.		
	TRIBE PHYLLANTHIÆ.		
1	Andrachne cordifolia [Leptopus cordifolius, Decc]	.	Very common.
2	Antidesma diandra .	Sarshoti ámli	Bhábar.
3	Phyllanthus (Hemiglochidion) nepalensis [Bradleia ovata, Wall Glochidion bifaria, Royle]	Bair mao ... ,, ,, ..	. Very common.
4	,, velutinus .. .	.	
5	,, (Emblica) Emblica .	Amla ...	Frequent
6	(Paraphyllanthus) urinaria .	Siáhi .	Common
7	(Euphyllanthus) parvifolius ..	..	Frequent.
8	Putranjiva Roxburghii .	Putrá jivá ..	Bhabar
9	Securinega (Fluggea) obovata [Phyllanthus retusus, Wall]	Dhám .	Common
10	,, leucopyrus [Phyllanthus albicans, Wall]	Ainta ..	...
11	Bischoffia Zeylaniæ [Andrachne trifoliata, Roxb]	Koisa ..	...

DIVISION III.—APETALÆ—(*continued*).

No	Scientific name.	Vernacular name	Note.
	ORDER 11.—EUPHORBIACEÆ—(concluded).		
	TRIBE BRIDELIEÆ.		
12	Bridelia stipularis	..	Rare
13	„ (Cluytia) montana ..	Karnaliya ..	Common
14	„ retusa ...	Khaja ..	Up to 3,000 feet.
	TRIBE ACALYPHEÆ.		
15	Trewia nudiflora ..	Túmri ...	Bhábar.
16	Mallotus philippinensis [Rottlera tinctoria].	Ryúni ..	Very common.
17	Ricinus communis	Ind, rendi	Common.
18	Homonoya riparia [Adelia, Madden].	Kandágar ..	Frequent.
	TRIBE HIPPOMANEÆ.		
19	Jatropha Curcas . .	Safed ind ...	Naturalized, Bhábar.
20	Baliospermum montanum [Croton polyandrus, Roxb.]		Common, Sarju bank.
21	Excæcaria (Triadica) sebifera ...	..	Introduced.
22	„ (Falconeria) insignis .	..	Common.
23	„ (Eu-excæcaria) acerifolia [Sapium, Madden, Stillingia himalayensis.]	Phulkiya ...	Very common, Sarju bank.
	TRIBE EUPHORBIEÆ.		
24	Euphorbia pentagona [Royleana] .	Sohund ...	Up to 6,000 feet.
25	„ angustifolia [dracunculoides, Roxb.]	Dúdhila and Mahábir.	Common up to 6,000 feet.
26	„ hirsuta [longifolia, Don.],	„	Above 6,000 feet (like Helioscopia)
27	„ peploides	...	Frequent.
28	„ pilulifera	.	Very common.
29	„ notoptera		Ganai Valley.
30	„ hypericifolia .	...	Col. Davidson.
31	„ thymifolia . .	...	„
32	„ pilosa	...	„
	ORDER 12.—DAPHNIPHYLLACEÆ.		
1	Daphniphyllum himalense [Gyrandra laurina, Wall. Ilicineæ *sp.*, Royle.]	Rakt chandan rakt anghya	Frequent. Used in marking the tika mark on forehead.
	ORDER 13.—BUXACEÆ.		
1	Buxus sempervirens .	Papar ...	Milam and Wán.
2	Sarcococca saligna Dec. [S. nepalensis, Royle].	Sakat sing...	Common, high levels.
	ORDER 14.—CANNABINACEÆ.		
1	Humulus lupulus .. .	...	Introduced.
2	Cannabis sativa	Bhang ...	Very common.

DIVISION III —APETALÆ—(*continued*).

No	Scientific name	Vernacular name	Note
	ORDER 15.—ULMACEÆ		
1	Ulmus Wallichiana [erosa, Roth	Chambar máya	Frequent Flowers precocious
2	„ parvifolia [virgata, Roxb]	„	Frequent Flowers coetaneous.
3	Holoptelea integrifolia [Ulmus integrifolia, Roxb]	Kanju	Common
4	Celtis australis [tetrandra,, Roxb]	Kharak	Very common and planted
5	Sponia politoria [Celtis tetrandra, Wall ?]	Khaoi, khák-si	Bhábar and valleys.
	ORDER 16.—MORACEÆ		
1	Streblus asper [Trophis aspera	Rusa	Bhábar
2	Plecospermum spinosum [Batis spinosa]		Rare
3	Morus indica	Shahtút	Frequent
4	„ lævigata	„	„
5	„ serrata	Kimu	Common Diœcious.
6	Ficus indica	Bar	Valleys
7	„ infectoria	Pákar	Bhábar
8	„ Tsiela	Kathbar	Planted
9	„ religiosa	Pipal	Valleys
10	„ cordifolia	Kabai pipal,	Common
11	„ retusa [nitida]		Bhábar
12	„ Carica	Anjír	Cultivated
13	„ virgata	Beru	Very common.
14	„ parasitica		Bhábar
15	„ scandens		Valleys
16	„ trachycarpa		„
17	„ Cunia	Kunia	Common
18	„ glomerata	Gular	Planted and banks of Kali.
19	„ macrophylla	Timla	Fruit eaten
20	„ oppositifolia	Totmila	Common
21	„ Luducca	Kabhula	„
22	„ laurifolia	Dudhila	„
23	„ ovata	Betuli	„
24	„ Chincha	Kismira	„
25	„ saxatilis		„
26	„ laminosa		„
27	„ acuminata		Bhábar
	ORDER 17.—ARTOCARPEÆ		
1	Artocarpus Lakoocha	Dháo	Introduced
2	Cudrania javanensis	Mánda	Bhábar.
	ORDER 18.—URTICACEÆ		
	TRIBE UREREÆ		
1	Urtica parviflora	Shishauna	Eaten: very common.
2	Girardinia heterophylla	Awa bichhu,	Very common

DIVISION III.—APETALÆ—(*continued*).

No	Scientific name	Vernacular name.	Note.
	ORDER 18.—URTICACEÆ - (concluded)		
	TRIBE PROCRIDEÆ		
3	Pilea scripta [goglado, Wall.] ...		Common, Naini Tál
4	Lecanthus peduncularis	Saochála	Very common, July, August
5	Elatostemma sessile [Procris punctata, Don]	„	„
6	„ platyphyllum	Gargela ..	Common
7	„ Strachcyanum	.	Rare
8	„ diversifolium .		Common, August.
	TRIBE BŒHMERIEÆ		
9	Bœhmeria rugulosa [nervosa, Madden]	Geti .	Common, dishes made of the wood
10	„ macrophylla	Saochála golka	Common.
11	„ platyphylla, *var* rotundifolia	Gargela ..	„
12	Chamabaina squamigera .	.	Bhábar
13	Pouzolzia viminea [sanguinea]		Frequent
14	Memorialis pentandra [Urtica pentandra, Roxb.	Jaiphal jari,	Common
15	„ hirta .	..	Frequent
16	„ quinquenervis .		„
17	Villebrunea frutescens, [Urtica frutescens, Madden]	Poi dhaula and kágshi	Common.
18	Debregeasia longifolia ...	.	Rare
19	„ bicolor [Bœhmeria salicifolia, Madden]	Tushyári . .	Very common; April.
20	*Maoutia Puya, [Bœhmeria frutescens,* Don]	*Phusai patta* and dhaula-kágshi	*Common up to 4,000* feet; Bhim Tál and Bageswar
	ORDER 19.—PIPERACEÆ.		
1	Piper sylvaticum	Pippula múl,	Common; Bhábar and valleys
2	Peperomia reflexa [saxatilis, Madden]	.	Very common on trees
	ORDER 20.—CORYLACEÆ		
1	Carpinus faginea .. .	Gish chamkharak.	Common.
2	„ viminea	„	„
3	Corylus lacera .. .	Kapási, bhotiya badám	Above 10,000 feet. Common, Joshimath.
4	Castaneopsis tribuloides ..	Kátonj ...	Frequent
5	Quercus incana ...	Bánj ..	Very common.

DIVISION III.—APETALÆ—(*concluded*).

No	Scientific name	Vernacular name.	Note.
	ORDER 20.—CORYLACEÆ—(concluded)		
6	Quercus lanata	Rianj ..	Frequent, Lariya kánta
7	„ semicarpifolia ...	Karshu .	Common, high elevations
8	„ dilatata .	Tilonj	Very common.
9	„ annulata .	Phalyant ...	Common, valleys
	ORDER 21.—JUGLANDACEÆ.		
1	Juglans regia .	Akhrot, ákor	Common
2	Engelhardtia Colebrookiana .	Mao	„
	ORDER 22. MYRICACEÆ		
1	Myrica sapida	Kaiphal ...	Very common
	ORDER 23.—BETULACEÆ		
1	Betula Bhojpatra .. .	Bhojpatra	Above 10,000 feet
2	„ (Betulaster) acuminata ... [cylindrostachys] .	Gaoul ... Shuoul	„ 8,000 „ Common
3	„ nitida ...	Paya-udesh,	„
4	Alnus nepalensis ...	Udesh .	Banks of all rivers
	ORDER 24.—SALICACEÆ		
1	Salix (Pleiandræ) tetrasperma .	Gar-bains ..	Common near streams.
2	„ „ acmophylla [dealbata, Jacq.]	..	Frequent
3	„ (Diandræ) babylonica ...	Majnua ...	Introduced.
4	„ „ Wallichiana .	Bains .	Common
5	„ „ elegans [kumaonensis, Lindley]	.	Top of China
6	„ „ daphnoides ..	...	Above 10,000 feet.
7	„ „ Lindleyana ..	..	„ „
8	Populus nigra [fastigiata]	.	Introduced
9	„ ciliata .	Gar pipal ..	Common
	ORDER 25.—LORANTHACEÆ.		
1	Viscum stellatum, Don .	Bánda .	Common on Pyrus
2	„ (Aphylla) articulatum ..	Ditto ..	Common on Quercus, incana and dilatata.
3	„ attenuatum .	Ditto .	Ditto
4	Loranthus (Euloranthus) ligustrinus,	.	Frequent, June
5	„ (Scurrula) pulverulentus,		Common; winter
6	„ „ cordifolius		Rare; December
7	„ „ vestitus .	.	Frequent, winter.
8	„ (Pentameria) longiflorus [bicolor, Roxb.]		Common; spring.

DIVISION IV.—GYMNOSPERMÆ.

No.	Scientific name	Vernacular name.	Note
	ORDER 1.—GNETACEÆ.		
1	Ephedra vulgaris [Gerardiana]	...	Above 10,000 feet, fruit edible
	ORDER 2.—CONIFERÆ.		
1	Pinus longifolia	Chír, salla	Very common
2	„ Gerardiana		Above 12,000 feet
3	„ excelsa	Rái salla	„ 10,000 feet, Kanol, Painkhanda
4	Abies Smithiana	Rágha	Above 10,000 feet.
5	„ Brunoniana [dumosa]	„	Rare, found by Captain Webb
6	Picea Pindrow	„	Common above 10,000 feet
7	„ Webbiana	„	„ „ 12,000 feet
8	Cedrus Deodara	Diyár	Introduced.
	ORDER 3.—CUPRESSINEÆ.		
1	Cupressus torulosa	Sarni	Naini Tál and Joshimath
2	„ sempervirens	...	Introduced
3	Juniperus (Oxycedrus) communis,	Chichuya	Milam and Niti, 12,000 feet
4	„ „ recurva	Bhedara	Rare.
	„ *var* squamata.	Bel bhedara,	Ilání Páni, 8,000 feet.
5	„ (Sabina) excelsa	Padam	Milam, 12,000 feet.
6	„ „ Wallichiana	Bhedara	Milam and Níti.
	Var squamosa, Madden ...	Bel bhedara,	Pindari, Painkhanda, *Rikholi gudri* A kind of yeast is made from this plant
	ORDER 4. TAXACEÆ.		
1	Taxus baccata	Thuner	Common.
2	„ nucifera	...	Rare; only found by Royle.

DIVISION V.—ENDOGENÆ.

No	Scientific name	Vernacular name	Note
	ORDER 1.—ZINGIBERACEÆ		
1	Curcuma angustifolia ..	Ban haldi	Up to 6,000 feet, May
2	„ longa [Kuchoor, Royle]	Haldi .	Cultivated up to 4,000 feet
3	Hedychium spicatum	Kachúr-kachur,	Common.
4	„ coccineum .		
5	„ villosum [Madden]	Rakt haldi ..	„
6	„ tenuiflorum [Murdan Ali]		Rare, Piyára
7	„ coronarium [flavum, Madden].	.. .	„ Gardens.
8	Roscoea purpurea .		
9	„ alpina .		Common; autumn.
10	„ lutea [gracilis] .		„
11	„ elatior .	...	.
12	Zingiber capitatum	.	Dákuri b náyak.
13	„ ligulatum	.	Bhábar.
	„ *var* chrysanthemum .		„
14	„ cassumunar [elatum, Madden?]	. .	Bhim Tál Bhábar; eaten by pigs.
15	„ officinale ..	Adrak .	Cultivated.
16	Amomum subulatum	Ilaichi .	Gardens
17	Costus speciosus .		Rare; valleys. Autumn.
18	Globba secunda	.	Bhábar.
	„ Orixensis?	..	„
	ORDER 2.—MARANTACEÆ.		
1	Canna speciosa .	Kiwára ...	Gardens
	ORDER 3.—MUSACEÆ.		
1	Musa sapientum .	..	Cultivated.
2	„ nepalensis .	.	River banks, Askot to Dhárchúla
	ORDER 4.—AMARYLLIDACEÆ		
1	Crinum toxicarium ..	Chandar kanwal	Common; July.
2	„ species .	.	Introduced.
	ORDER 5.—HYPOXIDACEÆ		
1	Curculigo recurvata .	Pitári .	Bhím Tál
2	„ orchioides .	„	Common up to 6,400 feet
3	Hypoxis minor ...	...	Very common
	ORDER 6.—IRIDACEÆ		
1	Pardanthus sinensis .	Katár pata	Very common.
2	Iris nepalensis	Nil-kanwal	Common.
3	„ kumaonensis ...	.	„
4	„ decora ..	...	Frequent
5	Tigridia pavonia .	.	Introduced

DIVISION V.—ENDOGENÆ—(*continued*).

No	Scientific name.	Vernacular name.	Note.
	ORDER 7.—HYDROCHARIDEÆ		
1	Vallisneria spiralis		Bhim Tál.
2	Hydrilla verticillata .		„
	ORDER 8.—ORCHIDACEÆ		
	TRIBE MALAXIDEÆ (END.)		
	SUB-TRIBE PLEUROTHALLIDEÆ		
1	Oberonia iridifolia	Bánda ...	Low elevations.
2	Microstylis Wallichii .	.	Colonel Davidson
3	Dienia cylindrostachya .. .	...	Common, Binsar, China, August
4	Liparis nepalensis . .	..	Lariya Kanta, Colonel Davidson August
5	Pholidota articulata		Common, April.
6	Cœlogyne nitida . .		Valleys.
7	„ præcox		Kotahgár. October.
8	„ ovalis ...		Binsar ; common, May
	SUB-TRIBE DENDROBIEÆ		
9	Eria convallarioides [Octomeria spicata]	Garar panja,	Common on oaks, June.
10	Dendrobium alpestre ..	.	Frequent
11	„ Pierardii [roseum ?] ..	..	Common, June.
	TRIBE EPIDENDREÆ (END.)		
12	Apaturia Smithiana . .	...	Bháhar
13	Phaius albus	.	Very common near Bhím Tal, June.
14	„ bicolor	..	Colonel Davidson
	TRIBE VANDEÆ.		
15	Cymbidium triste [Luisia trichorhiza]	..	Frequent, low levels.
16	Eulophia compestris ..	..	Rare Bháhar Salep made from root
17	„ herbacea ..		Frequent, sweet scented.
18	Cyrtopera fusca (flava, Royle Ill) .	.	Common up to 4,500 feet. May.
19	Vanda cristata	Bánda ..	Common, on trees June.
20	Saccolabium guttatum ..	.	Very common, low elevations. May, June.
21	„ bapillosum [Cymbidium præmorsum, Roxb.],	...	Haldwani, on Ulmus integrifolia
22	Aerides affine . .	...	Common. June.
23	„ odoratum [cornutum, Roxb],	..	Colonel Davidson.
24	Calanthe plantaginea	Hyacinth orchis.	Very common. April.

DIVISION V.—ENDOGENÆ—(*continued*).

No	Scientific name.	Vernacular name	Note.
	ORDER 8.—ORCHIDACEÆ—(concluded)		
	TRIBE OPHRYDEÆ.		
25	Orchis latifolia	...	Phulsain near Joshimath, June.
26	Aceras angustifolia	...	Very common
27	Platanthera Susannæ .	...	Ramgár, September
28	„ obcordata . .	...	Near Naini Tal Brewery, September.
29	„ acuminata	...	Naini Tal Colonel Davidson
30	Hemipilia cordifolia . .	...	Near Khairna, September
31	Peristylus goodyeroides .	...	Frequent.
32	Herminium Monorchis .	...	Top of Lariya Kánta, August.
33	„ gramineum . .	...	Rare
34	Habenaria pectinata .	...	Common, September
35	„ intermedia	...	„ „
36	„ marginata . ..	...	Very common, August, September
37	„ ensifolia ...	...	Colonel Davidson.
38	„ plantaginea ...	...	„ „
39	„ rostrata, Madden .	...	Perhaps same as emarginata No 36
40	Gymnadenia commelynæfolia, Madden	...	On Kálimath, 6,000 feet.
41	Satyrium nepalense	Pakwa-dimni,	Very common, August, September.
	TRIBE GASTRODIEÆ		
42	Epipogium Gmelini .	...	Colonel Davidson
	TRIBE NEOTTIEÆ		
43	Spiranthes australis	...	Very common, August, September.
44	Epipactis latifolia . ..	...	Common
45	„ macrostachya	...	„
46	Goodyera repens . .	...	„
47	„ procera	...	Binsar, August.
48	Zeuxine sulcata	...	Winter, Bhábar.
	TRIBE ARETHUSEÆ		
49	Cephalanthera acuminata ...	...	Common, under trees, May
	TRIBE CYPRIPEDIEÆ.		
50	Cypripedium cordigerum ..	...	Lariya Kánta, May. Colonel Davidson.

DIVISION V.—ENDOGENÆ—(*continued*).

No	Scientific name.	Vernacular name.	Note.
	ORDER 9.—PALMACEÆ		
1	Chamærops Martiana	Thákil	Frequent.
	„ *var* khasyana, Madden.	„	„
2	Wallichia densiflora [Harina oblongifolia.]	Kála-aunsa.	Common, valleys
3	Phœnix sylvestris, *var.* humilis Madden	Khajur	Up to 5,000 feet. Binsar
4	„ acaulis	...	Bhábar
5	Calamus Royleanus, [C. Rotang ?]	Bet	„
	ORDER 10.—PONTEDERIACEÆ.		
1	Pontederia (Monochoria) hastata. [P. vaginalis, Madden.]	...	Common. Rice fields.
	ORDER 11.—MELANTHACEÆ		
1	Disporum Pitsutum	..	Common
2	„ Leschenaultianum [Uvularia Leschenaultii, Madden.]		„
3	„ Wallichii		Frequent.
4	„ Hamiltonianum	..	„
5	Iphigenia indica [Anguillaria indica, Brown.]	...	Common
	ORDER 12.—LILIACEÆ		
	TRIBE TULIPEÆ		
1	Tulipa stellata	Majaula, nalku,	Common up to 7,000.
2	Gagea elegans	..	„ above 10,000 feet.
3	Lloydia serotina?	...	Common.
4	„ himalense	...	Above 10,000 feet.
5	Fritillaria verticillata	...	Phulsain, 8,000 feet
6	„ Thomsonianum	.	Common, April
7	Lilium Wallichianum	Findora	Common, Ránibagh.
8	„ nepalense		„
9	„ giganteum	Bhumiya nar,	Above 10,000 feet.
10	Methonica [Gloriosa] superba	Bish nángal,	Valleys.
11	Hemerocallis fulva [disticha]	...	Above 10,000 feet.
	TRIBE ALOINEÆ.		
12	Aloe perfoliata	Ghikwár	Valleys, April.
13	Yucca gloriosa	Rámbáns	Naturalized.
	TRIBE HYACINTHEÆ.		
14	Uropetalum	...	Rare, Kálimath.
15	Urginea indica [Scilla indica, Madden]	Gesna	Common
16	Allium leptophyllum	Piriya láhsan	Outer range.
17	„ Wallichii	Paderiya láhsan.	„
18	„ ellipticum	Sheolia láhsan.	
19	„ Jibbu	Jibbu	About 10,000 feet
20	„ Argand	Argand	Háaipáni, 8,000 feet.

DIVISION V.—ENDOGENÆ—(*continued*).

No.	Scientific name.	Vernacular name.	Note
	ORDER 12.—LILIACEÆ.—(*concluded*)		
	TRIBE ASPARAGEÆ		
21	Asparagus racemosus . .	Ailora	Bhábar
22	,, filicinus .	Khairuwa	Common, edible.
23	,, adscendens		Common.
24	Polygonatum verticillatum ..	.	,,
25	,, multiflorum .	..	,,
26	,, cirrhifolium ? [Sibiricum ?]	. .	,,
27	Smilacina pallida . .	...	,,
28	,, alpina . .	..	Kedár.
	TRIBE OPHIOPOGONEÆ.		
29	Ophiopogon intermedius	.	Frequent
30	,, Wallichianus [spicatum, Madden].	...	Common
	ORDER 13.—COMMELYNACEÆ		
	SECTION OLIGANDRIÆ.		
1	Commelyna (Eucommelyna) salicifolia	.	Frequent
2	,, ,, bengalensis ..	.	,,
3	,, (Trithyrocarpus) obliqua	Kána ..	Very common
4	Aneilema scapiflorum, [Murdannia scapiflora, Royle]	. .	Common up to 4,000 ft.
5	,, lineolatum . .	.	Above 5,000 feet.
6	,, protensum ..	..	Rare.
	SECTION HEXANDRIÆ		
7	Dithyrocarpus, paniculatus [rufus, Kunth]	Kandera .	Common
8	Cyanotis axillaris	. .	Bhábar
9	,, cristata	.	,,
10	,, barbata		Common.
11	,, racemosa . ..	. .	Bhábar
12	Streptolirion volubile	. .	Rare
	ORDER 14.—ALISMACEÆ		
1	Sagittaria sagittifolia ...	. .	...
	ORDER 15.—JUNCEÆ		
1	Juncus bufonius . . .	Shim ..	Common.
2	,, glaucus	..	Frequent.
3	,, concinnus . .		,,
4	,, Wallichianus . .	...	...
	ORDER 16.—SMILACEÆ		
1	Smilax villandia, Royle . .	Kukar dhára	Common
2	,, macrophylla	,,	Frequent.
3	,, maculata .	.	,,
4	,, vaginata	.	Rare, China

DIVISION V.—ENDOGENÆ—(*continued*).

No	Scientific name	Vernacular name.	Note
	ORDER 17.—DIOSCOREACEÆ		
1	Dioscorea versicolor ..	Genti .	Frequent
2	„ sagittata . .	Tari tagur .	Tubers edible.
3	„ pentaphylla .. .	Magina muniya	
4			Tubers edible.
5	„ deltoidea .. .	Gún	Above 6,000 feet.
	ORDER 18.—AROIDEÆ		
	TRIBE DRACUNCULEÆ		
1	Arisæma speciosa	Sarp ka goga,	Common.
2	„ Jacquemontii	„	Very common.
3	„ costatum .. .	„ .	Common.
4	„ curvatum	„ ..	„
5	Arum hastatum .	„ .	Common, July
6	Sauromatum guttatum . .	.	„
7	„ punctatum? .	Kála bank .	Káladhúngi
8	Amorphophallus campanulatus [Arum campanulatum, Roxb.]	..	Bhábar
9	Typhonium?	„ ...	Common, July, very fœtid.
	TRIBE CALADIEÆ		
10	Remusatia vivipara	Baghpindálu,	Up to 4,500 feet
11	„ capillifera [Caladium pumilum, Don?	Bánj pindálu,	Above 5,000 feet, flowers, June
12	Colocasia Roxburghii	Jangli gwia Gar pápar.	Very common
13	„ himalensis	Gwia and pápar.	Cultivated.
	ORDER 19.—ORONIACEÆ		
1	Acorus calamus	Bach bij .	Rare.
2	Scindapsus officinalis, Pothos officinalis, Roxb.]	Hathangliya,	Near Bhim Tál.
3	„ decursivus [Pothos decursivus]	Kelauniya ..	Binsar.
4	Pothos scandens	..	
	ORDER 20.—TYPHACEÆ		
1	Typha elephantina	Padera, petára	Bhábar
2	„ angustifolia	Bora ..	Marshes
	ORDER 21.—JUNCAGINACEÆ		
1	Potamogeton natans	...	Bhim Tál and Naini Tál
2	„ mucronatum ...	..	„ „
3	„ crispum . .	.	„ „
4	„ pectinatum ...		„ „
5	„ perfoliatum ..	...	„ „

DIVISION V.—ENDOGENÆ—(*continued*).

No.	Scientific name	Vernacular name	Note.
	ORDER 22.—LEMNACEÆ		
1	Lemna minor	..	Bhábar
2	„ polyrhiza [orbiculata, Roxb.]	...	Streams, up to 4,000 feet
	ORDER 23.—GRAMINEÆ.		
	Tribe Oryzeæ.		
1	Oryza sativa	Dhan ..	Cultivated.
	Tribe Phalarideæ.		
2	Zea Mays	Bhuta	Cultivated.
3	Coix Lacryma .. .	Lakochiya ..	Common.
4	„ gigantea	„ ..	Frequent
	Tribe Paniceæ		
5	Paspalum longiflorum .. .	Kána ..	Rice fields.
6	Panicum (Digitaria) cruciatum [Roylei, Madden.]	.	Frequent
	„ *var* distachyus	..	„
	„ octostachyus .	...	„
7	Panicum (Orthopogon) acuminatissimum		Colonel Davidson.
8	Panicum (Echinochloa) colonum ...	Jangli mandira	Common
9	„ frumentaceum	Jhangora and mandira.	Cultivated
10	„ homonymum chamæraphis Madden].		Very common
11	„ (Setaria) glaucum ...	...	„
12	„ Italicum ..	Kangni koni,	Cultivated.
13	„ (Virgaria) miliaceum .	China ...	„
14	Pennisetum triflorum ..	Bimalsiya ..	Common.
15	Arundinella setosa [hirsuta, Madden]	.	„
16	„ nepalensis [miliaris, Madden,	..	„
17	Thysanolæna agrostis . ..	Amisa .	Very common.
	Tribe Stipaceæ		
18	Arachne (Piptatherum) holciformis,		Colonel Davidson.
19	Aristida cyanantha .	Binniya & kakal sena.	Very common.
	Tribe Agrostideæ		
20	Vilfa elongata [Sporobolus elongatus Madden]	..	Common.
21	Agrostis alba . .	..	Colonel Davidson.
22	Muhlenbergia sylvatica	.	Rare
23	„ geniculata	.	„
24	Polypogon fugax	Giwa gioliya,	Common.
25	Perotis latifolia . .	..	„
	Tribe Arundinaceæ.		
26	Phragmites Roxburghii . ..	Bichia, nal	Common
27	„ Karka .	Karka „ ..	„
28	„ nepalensis	Nal tura ...	Bhim Tál.

DIVISION V.—ENDOGENÆ—(*continued*).

No	Scientific name	Vernacular name	Note
	ORDER 23.—GRAMINEÆ—(continued).		
	TRIBE CHLORIDEÆ		
29	Chloris decora	.	Common.
30	Cynodon dactylon	Dub	Very common.
31	Eleusine coracana	Manduwa	Cultivated
32	„ indica	..	Common.
	TRIBE AVENEÆ.		
33	Avena sativa	Jai	Cultivated,
34	„ fatua	Jai-ata	Common.
	TRIBE FESTUCEÆ.		
35	Poa annua	...	Introduced
36	„ bulbosa	.	„
37	„ trivialis	...	„
38	Eragrostis cynosuroides	..	Common
39	„ caudata	...	„
40	„ nutans	..	Col Davidson.
41	„ amabilis	...	„
42	„ ciliata	...	Common.
43	„ plumosa	.	Very common
44	„ diarrhena	.	Col Davidson
45	„ nardoides	.	Common
46	„ orientalis	..	October.
47	Koeleria cristata	...	Very common, April.
48	Dactylis glomerata	...	Frequent.
49	Festuca (Brachypodium) nepalensis,	...	Common.
50	Tripogon (Plagiolytrum) filiforme,	..	„
	TRIBE BAMBUSEÆ.		
51	Arundinaria falcata	Ringál and Ningál.	Very common.
	(Two *varieties*)	.	...
52	Thamnocalamus spathiflorus	Ringál	Dúdatoli
53	„ Falconeri	Káli ringál.	Common, May.
54	Dendrocalamus strictus	Báns	Bhábar
55	„ *sp.*	„	Dhamas; cultivated
	TRIBE HORDEACEÆ.		
56	Lolium temulentum	..	Bhábar.
57	Triticum vulgare	Lál gehún	Cultivated.
58	„ striatum	.	Rare.
59	Hordeum hexastychum	Jao	Cultivated
60	„ himalayense [cœleste]	Ua jao	„ above 10,000 ft.
	TRIBE ROTTBOELLIACEÆ		
61	Ophiurus perforatus	...	Very common.
62	Rottbœllia exaltata	...	Frequent.
63	„ hirsuta	...	Rare
64	„ lævis [Mnesithia lævis],	...	„
65	Manisurus granularis	..	Frequent.

DIVISION V.—ENDOGENÆ—(*continued*).

No.	Scientific name	Vernacular name	Note.
	ORDER 23.—GRAMINEÆ.—(concluded)		
	TRIBE ANDROPOGONEÆ		
	ANDROPOGON, WITH NUMBER IN STEUDEL.		
66	Heteropogon contortus, 37 ..	Kumariya .	Common.
67	„ polystachyus, 42	„ .	„
68	Ischæmum corollatus, 65	Noniya .	Frequent
69	Ischæmonea speciosus, 132 ...	...	„
70	Spodiopogon involutus, 117 ..	.	„
71	Apocopis himalayensis, 168 ..	.	Rare
72	Bathratherum lancifolius, 237 ..	.	Common.
73	„ micans, 239 ..	..	„
	TRIBE ANDROPOGONEÆ.		
74	Bathratherum submuticus 210 ..	..	Common.
75	Cymbopogon pachnodes, 297 .	..	„
76	„ distans, 298 ...	.	„
77	„ versicolor, 301 .	Píriya ..	Very common, Naini Tal
78	„ pendulus, 303 ..	..	Common.
79	„ Iwarankusa, 306 ...	Miriya ...	„
80	„ Martini, 309 ..	..	Bhábar.
81	„ flexuosus, 310	Bujara... ..	Very common A'mora.
82	Andropogon erythrocoleos, 341 .	...	Common.
83	„ punctatus, 343 ..	Pagrimalsi.	Very common
84	„ controversus, 349 ...	.	Very common, October.
85	„ montanus, 352	.	Colonel Davidson
86	Sorghum halepensis, 384 ..	..	Common.
87	Anatherum muricatus, 393 ...	Gandar, kaskas,	„
88	Chrysopogon cœruleus, 404 ..	Gweriya, parmal.	„
89	„ Trinii, 408 ..	.	Rare
90	„ Royleanus, 425	Salim .	Common.
91	„ echinulatus 426 ..	„ ..	„
92	„ villosulus, 427	..	.
93	„ glaucopsis, 429 .	..	Rare
94	„ subrepens, 430 ..	..	„
95	„ parvispica [Rhaphis microstachys,] 431	Palkiya, chiraula	Very common
96	Spodiopogon petiolaris, 443 ..	.	Common, Naini Tal, July
97	Anthistiria arundinacea .	Ullu, kanyur,	Bhábar and valleys.
98	„ anathera	Jyotish-mati,	Roots luminous
99	Imperata arundinacea [cylindrica Lam],	Shiro ...	„
100	Saccharum spontaneum	Jhansh ...	„
101	„ Sara . ..	Sarur .	Bhábar.
102	„ semidecumbens ...	Tat, mora ..	„
103	„ exaltatum . ..	..	„
104	„ Munja . .	Munj ✓ .	„
105	Erianthus olivaceus, Elgw. ..	Kans ✓	Common.
106	„ vulpinus, Edgw. ..	...	„
107	„ filifolium, Nees. ..	..	„
108	„ rufum, Nees.	...	„
109	„ rufipilum, Stend. ..	..	„
110	Leptatherum Royleanum ..	..	Rare.
111	Pollinis *sp.*	...	Frequent.
112	Eulalia japonica	...	„

DIVISION V.—ENDOGENÆ—(*continued*).

No	Scientific name	Vernacular name	Note
	ORDER 24.—CYPERACEÆ.		
	TRIBE CYPEREÆ.		
1	Cyperus (Pycreus) capillaris ?	...	...
2	„ diaphanus ?	...	
3	„ angulatus	...	...
4	„ alopecuroides ?		...
5	„ (Eucyperus) compressus	...	
6	„ difformis	...	
7	„ Iria	...	Common
8	Cyperus niveus	...	Very common
9	„ tegetiformis	Motha ...	Cultivated.
10	„ tenuiflorus	...	Common, August.
11	„ rotundus [hexastachyos, Roxb.]	...	„
12	„ obliquus	...	„
13	„ pusillus [pygmæus, Retz.]	...	...
14	„ Wallichianus	...	...
15	„ *fimbriatus*	...	...
16	„ dilutus	...	Very common.
17	Mariscus cyperinus	Panmotha and nagarmotha.	Common
18	Kyllingia monocephala	Nirbisi	„
19	„ triceps	„ ...	„
	TRIBE SCIRPEÆ.		
20	Abildgaardia monostachya	...	...
21	Eleocharis palustris	...	...
22	„ uniglumis	...	...
23	Eleogenus ovata	...	...
24	„ capitata	...	...
25	Scirpus juncoides [muticus]	...	...
26	„ lacustris	...	Bhím Tál
27	„ affinis [maritimus]	...	...
28	Isolepis setacea	...	...
29	„ supina	...	
30	„ Roylei	...	...
31	„ trifida	...	Common.
32	Fimbristylis pallescens	...	...
33	„ junciformis	...	Very common, August.
34	„ subtristachya [communis]	...	Common
35	„ quinquangularis	...	„
36	Eriophorum comosum	Bábar ...	Very common, autumn.
	TRIBE HYPOLYTREÆ.		
37	Lipocarpha argentea	...	Very common, July and August.

DIVISION V.—ENDOGENÆ—(*concluded*).

No	Scientific name.	Vernacular name	Note.
	ORDER 24.—CYPERACEÆ—(concluded).		
	TRIBE RHYNCOSPOREÆ		
38	Rhynchospora chinensis ..	...	...
39	„ Wallichiana	...	...
	TRIBE CARICINEÆ.		
40	Carex (Androgynæ) longipes . .	...	...
41	„ foliosa ..	. .	...
42	„ nubigena .	..	Common.
43	„ notelem	. .	...
44	„ Vahlii [alpina] .. .	.	. .
45	„ hæmatostoma . .	...	...
46	„ setigera	.	..
47	„ myosurus	...	Above 5,000 feet, May.
48	„ condensata	...	Common.
49	„ filicina . .	. .	„
50	„ (Bifidæ) saxatilis [rigida, Good]	..	. .
51	Carex notha ...	...	...
52	„ acuta [gracilis, Curtis] ..	...	. .
53	„ (Trifidæ), ligulata ...	...	...
54	„ cardiolepis .. .	..	. .
55	„ Royleana . ..	.	..
56	„ Moorcroftii	.	..
57	„ emodorum [alopecuroides Don],	. .	...
58	„ obscura	..	...
59	„ fusiformis . .	...	...
60	„ Wallichiana .. .	.	...
61	„ cruenta . .	.	...
62	„ (Incertæ) Thomsonii, Boott,		...
63	„ mitis, Boott ...	..	...
64	„ uncinoides, Boott	.	...
65	„ vesiculosa, Boott. .	..	...
66	Uncinia nepalensis	. .	...
	ORDER 25.—ERIOCAULONEÆ		
1	Eriocaulon sexangulare	...	Very common, swamps.
	ORDER 26.—TRILLIACEÆ		
1	Paris polyphylla	...	Common.
2	Trillium Govanianum, Royle ...	...	Kúlára Pass, 11,000 feet.

DIVISION VI.—ACROGENÆ.

No.	Scientific name	Vernacular name	Note.
	ORDER I.—FILICES.		
	TRIBE GLEICHENIACEÆ		
1	Gleichenia dichotoma ...	...	Common.
	TRIBE DICKSONIEÆ		
2	Woodsia lanosa . ..	...	Rare, Dudatoli.
3	„ elongata .. .	..	Common
4	Dicksonia appendiculata [Sitolobium, J Smith]	...	„
	TRIBE HYMENOPHYLLEÆ		
5	Hymenophyllum poyanthus [exsertum ?]	..	On trees, Binsar, October J. H Batten.
	TRIBE DAVALLIEÆ.		
6	Davallia (Leucostegia) membranulosa,	.	Frequent.
7	„ „ immersa .	.	„
8	„ „ multidentata? pulchra ?	.	Rare.
9	„ „ chærophylla [cystopteris, D C]	.	Common, Binsar.
10	„ „ nodosa [Acrophorus Presl]		Rare.
11	„ (Endavallia) divaricata (elegans, Madden)	...	Very common.
12	„ (Microlepia) Hookeriana .	..	Bhabar
13	„ „ speluncæ	...	„
14	„ (Stenoloma) tenuifolia .	..	Common
	TRIBE PTERIDEÆ		
15	Adiantum lunulatum .. .	...	Common.
16	„ caudatum [rhizophorum Swartz]	.	Very common.
17	„ Capillus-veneris ..	Mubáraka ..	Common.
18	„ venustum .. .	Hansráj ...	„
19	„ pedatum		„
20	Cheilanthes Dalhousiæ . ..	..	„
21	„ farinosa [dealbata ..	...	Very common.
22	Onychium auratum	..	Common
23	„ japonicum . .	..	„
24	Pellæa [Cheilopleccion] gracilis .	...	Rare; resembles Cryptogramma crispa.
25	„ [Allosorus nitidula ..	..	Rare.
26	„ [Platyloma] calomelanos ..	Bish kutra	On rocks at low levels.
27	Pteris (Eupteris) longifolia .	..	Very common.
28	„ „ cretica .	...	„ „
	„ „ *var* stenophylla ..	...	Common.
29	„ „ quadri aurita	...	Very common.
30	„ (Pæsia) aquilina	...	Very common.
31	„ (Campteria) biaurita ..	...	Rare.
32	„ „ Wallichiana .	...	Common.
33	„ (Litobrochia) incisa .	...	Near Ramghár, J. H. Batten

DIVISION VI.—ACROGENÆ—(*continued*).

No	Scientific name	Vernacular name	Note.
	ORDER I.—FILICES—(continued).		
	TRIBE BLECHNEÆ		
34	Woodwardia radicans	..	Low levels, very common
	TRIBE ASPLENIEÆ		
35	Asplenium (Euasplenium) ensiforme	...	Common. Bunsar, July
36	„ „ alternans		Very common on walls.
37	„ „ viride .	..	Above 12,000 feet.
38	„ „ trichomanes	..	Common
39	„ „ resectum		Frequent
40	„ „ planicaule	..	Common
41	„ „ adiantum nigrum	...	Rare
42	„ „ fontanum,	..	Frequent.
43	„ „ varians .	...	„
44	„ „ bulbiferum,		Rare.
45	„ „ tenuifolium [concinnum Wall]	..	„
46	„ (Athyrium) thelypteroides.	...	Colonel Davidson.
47	„ „ macrocarpum [foliolosum Wall].	..	Common.
48	„ „ nigripes	..	Colonel Davidson.
49	„ „ filix femina [pectinatum]	...	Common
50	„ „ oxyphyllum	...	Colonel Davidson.
51	„ „ fimbriatum,	.	„
52	„ „ umbrosum [Allantodia australe]	.	Rare
53	„ (Diplazium) polypodioides	Langra ...	Common.
54	„ „ maximum	„ ..	„ edible.
55	„ (Anisogonium esculentum.	...	„ not edible.
56	„ (Hemidictyum) Ceterach [Ceterach		Rare; Very like Asplenium alternans
57	Actiniopteris radiata	Morpuchh ...	Common, walls, Srinagar.
	TRIBE ASPIDIEÆ		
58	Aspidium (Polystichum) auriculatum,	...	Common
59	„ „ ilicifolium	...	„
60	„ „ Thomsoni	..	Above 8,000 feet.
61	„ „ aculeatum .	..	Common
.	„ „ *var.* rufobarbatum, Wall.	..	Very common
62	„ „ Prescottianum,	...	Colonel Davidson.

DIVISION VI.—ACROGENÆ—(*continued*).

No.	Scientific name.	Vernacular name	Note.
	ORDER I.—FILICES—(continued)		
	TRIBE ASPIDIEÆ—(concluded)		
63	Aspidium (Polystichum) aristatum (coniifolium Wall.)	.	Bhábar.
64	„ (Cyrtomium) falcatum	..	Frequent
	„ „ *var* caryotidium	.	Very common
65	Nephrodium (Lastrea) patens .	..	Colonel Davidson.
66	„ „ canum .	.	„
67	„ „ prolixum .	..	Common
68	„ „ filix mas ...	...	Very common.
..	„ „ *var* cochleatum	.	Common
69	„ „ flaccidum .	..	„
70	„ „ spinulosum .		Very common
71	„ „ sparsum .	.	Common
72	„ „ odoratum (eriocarpum, H. K.)	Katra	Very common, edible
73	„ „ angustifrons,	..	Frequent.
74	„ (Eunephrodium) unitum	.	„
75	„ „ cucullatum (unitum, Sieb.).	.	Bhábar.
76	„ „ aridum	..	Colonel Davidson.
77	„ „ molle .	.	Frequent
78	„ (Sagenia) polymorphum .	Lingra .	Up to 4,000 feet
79	„ „ variolosum .	.	Rare.
80	„ „ cicutarium .	..	Common
81	Nephrolepis cordifolia [tuberosa H. K.]	...	Rare, Pipa kothi
82	Oleandra neriiformis . ..	..	Common.
83	„ Wallichii	...	„
	TRIBE POLYPODIEÆ.		
84	Polypodium (Phegopteris) erubescens	...	Low elevations.
85	„ „ distans ..	...	Common.
86	„ (Goniopteris) urophyllum,	..	
87	„ „ proliferum,	...	Bhábar.
88	„ „ lineatum ...	..	Valleys.
89	„ „ multilineatum	.	„
90	„ (Goniophlebium) amœnum,	..	Common
91	„ „ lachnopus .	..	„
92	„ „ subauriculatum (argutum, Wall.)	..	Frequent.
93	Polypodium (Niphobolus) adnascens,	.	Common
94	„ „ lingua ..	.	„
95	„ „ stigmosum,	..	Valleys.
96	„ „ fissum	...	Common, June.
97	„ „ (flocculosum).	...	Rare
98	„ (Phymatodes) lineare [Pleopeltis nuda]	..	Scented fern; very common on trees
99	„ „ normale ..	...	Common.

DIVISION VI.—ACROGENÆ—(*continued*).

No.	Scientific name.	Vernacular name	Note.
	ORDER I.—FILICES—(concluded)		
	TRIBE POLYPODIEÆ—(concluded).		
100	Polypodium (Phymatodes) membranaceum	...	Common.
101	„ „ trifidum [oxylobum, Wall]	...	Frequent.
102	„ „ malacodon,	...	Rare
103	„ „ ebenipes	..	„
104	„ (Drynaria) propinquum,	.	Common.
105	„ „ rivale ...	..	„
106	„ „ quercifolium	...	Bhábar
107	„ „ juglandifolium,	.	Common.
108	„ „ himalayense [venustum, Wall]	..	Frequent.
	TRIBE GRAMMITIDEÆ.		
109	Gymnogramma (Leptogramma) Totta,	...	Colonel Davidson.
110	„ (Engymnogrammia) vestita,	Mouse ear fern.	Pyúra and China.
111	„ „ Andersoni,	...	About 13,000 feet
112	„ „ javanica	..	Binsar. August.
113	„ (Sellignea) lanceolata,	...	Rare.
114	„ „ involuta .	..	Common
115	Vittaria (Euvittaria) elongata	..	Binsar.
116	„ (Tœniopsis) scolopendrina ?	...	Binsar, June
	TRIBE ACROSTICHEÆ		
117	Acrostichum virens .. .	...	Bhábar.
	„ *var* deltigerum [Meniscium deltigerum, Wall].	...	„
	TRIBE OSMUNDACEÆ		
118	Osmunda Claytoniana [interupta] ..	..	Very common 10,000 feet Chaupatta.
119	„ regalis *var.* japonica ..	...	Rare Kháti 10,000 feet. May.
	TRIBE SCHIZÆACEÆ		
120	Schizæa digitata . .	.	Common.
121	Lygodium scandente . ..	Marora, bandhaniya	Bhábar.
122	„ japonicum	„ .	Common
	TRIBE MARATTIACEÆ.		
123	Angiopteris erecta .	...	Rare.
	TRIBE OPHIOGLOSSACEÆ		
124	Ophioglossum vulgatum ..	...	„
125	Botrychium lunaria	...	Binsar
126	„ daucifolium . ..	...	Common.
127	„ virginianum ..	...	Very common.
	var. lanuginosum ...	...	Common.

DIVISION VI.—ACROGENÆ—(*continued*).

No.	Scientific name.	Vernacular name.	Note.
	ORDER 2—EQUISETACEÆ.		
1	Equisetum debile	...	Bhábar
2	„ diffusum, Don [scoparium, Wall]	...	Hill streams
	ORDER 3—LYCOPODIACEÆ.		
1	Lycopodium tenellum ...	...	Very common.
2	„ setaceum ...	...	Rare.
3	„ circinatum ...	...	Frequent, 4,000 feet.
4	„ subulifolium ...	Tula muka ..	Common.
	ORDER 4—MARSILIACEÆ.		
1	Marsilia quadrifolia	...	Bhábar.
	ORDER 5—SALVINIACEÆ		
1	Azolia pinnata	Taráí ...	Common in pools.
	ORDER 6—CHARACEÆ.		
1	Chara verticillata	...	Naini Tál and Bhím Tál.
	ORDER 7.—BRYACEÆ.		
	TRIBE DICRANACEÆ.		
1	Leptotrichum inclinatum, Mitten.	...	Hoti.
2	„ molliculum, Mittin ...	...	Common.
3	„ himalayanum Mitten.	...	„
4	Dicranum himalayanum, Mitten ...	..	...
5	„ reflexifolium, Muller.	...	...
6	Didymodon laxifolius	...	...
	TRIBE LEUCOBRYACEÆ.		
7	Octoblepharum albidum ...	...	Bhábar.
	TRIBE TRICHOSTOMACEÆ.		
8	Tortula squarrosa	...	Common.
9	„ anomala	...	...
10	Anœctangium Roylei, Mitten ...	...	...
11	„ Thomsoni, Mitten ..	...	...
12	„ Stracheyanum, Mitten ...	..	...

DIVISION VI.—ACROGENÆ—(*continued*).

No	Scientific name	Vernacular name.	Note.
	ORDER 7.—BRYACEÆ—(continued)		
	TRIBE TRICHOSTOMACEÆ—(concluded)		
13	Hymenostylium aurantiacum, Mitten,	...	...
14	,, curvirostrum ...	...	...
15	Barbula vinealis ...	...	...
16	,, sub-pellucida, Mitten ...	...	...
17	,, gracilenta, Mitten ...	...	...
18	,, nigrescens, Mitten ...	...	...
19	Desmatodon Laureri ...	...	...
20	,, Wallichii ...	...	...
21	,, involutus ...	...	...
22	Encalypta ciliata ...	...	...
	TRIBE GRIMMIACEÆ		
23	Grimmia apocarpa ...	...	Rocks, common.
24	,, (Rhacomitrium) subsecunda,		,, ,,
25	Glyphomitrium tortula, Mitten ...	...	...
	TRIBE ORTHOTRICHACEÆ		
26	Orthotrichum Hookeri ...	...	...
27	Macromitrium Moorcroftii	...	...
	TRIBE FUNARIACEÆ		
28	Funaria hygrometrica ...	...	Very common, summer.
29	,, leptopoda ...	...	...
	TRIBE SPLACHNACEÆ.		
30	Tayloria indica ...	...	...
31	,, (Dissodon) tenella, Mitten,	...	October
	TRIBE BARTRAMIACEÆ.		
32	Bartramia Halleriana ...	...	...
33	,, leptodonta ...	...	Near Ithyphylla.
34	,, subpellucida, Mitten ...	...	Resembles ,,
35	Philonotis Turneriana ...	...	Common
36	,, falcata ...	...	,,
	TRIBE BRYACEÆ.		
37	Mielichoferia himalayana ...	...	Pindari, 11,000 feet.
38	Webera elongata ...	...	...
39	Bryum filiforme, Mitten ...	...	...
40	,, argenteum ...	...	Very common.

DIVISION VI.—ACROGENÆ—(*continued*).

No	Scientific name	Vernacular name	Note.
	ORDER 6 —BRYACEÆ—(continued).		
	TRIBE BRYACEÆ—(concluded)		
41	Bryum hemisphaericum...		...
42	„ alpinum	.	Common.
43	„ cernuum		„
44	„ Warneum		„
45	„ turbinatum		Common, summer
46	„ roseum	..	Very common, summer
47	„ nepalense	..	Common, summer.
	TRIBE HYPNACEÆ		
48	Fabronia minuta	..	...
49	Hypnum argentatum, Mitten	.	...
50	„ Buchanani	...	..
51	„ cameratum, Mitten	...	.
52	„ kamounense	.	..
53	„ plumosum		.
54	„ rusciforme	...	.
55	„ commutatum	.	.
56	„ filicinum		...
57	Meteorium squarrosum	.	Common.
58	Stereodon condensatus, Mitten	.	Ditto, summer.
59	„ caperatus, Mitten	...	
60	„ taxirameus, Mitten	.	.
61	„ plicatus [Neckera]	...	.
62	„ prorepens, Mitten	...	
63	„ macrocarpus	...	
64	„ serrula, Mitten	...	Diwáli, 8,500.
	TRIBE NECKERACEÆ.		
65	Neckera Stracheyana	...	..
66	„ crenulata	...	...
	TRIBE LEUCODONTACEÆ		
67	Hedwigia attenuata	...	Above 10,000.
68	Leucodon secundus	...	Common
69	Cryphæa concavifolia	...	Binsar June. Common
	TRIBE LESKEACEÆ		
70	Anomodon tristis	...	...
71	„ acutifolius, Mitten	...	...
72	Trachypus blandus [Neckera]	...	...
73	„ Buchanani [Neckera]	...	...
74	Leskea scopula, Mitten ..	...	...

DIVISION VI.—ACROGENÆ—(*concluded*).

No.	Scientific name	Vernacular name	Note.
	ORDER 7—BRYACEÆ—(concluded)		
	TRIBE LESKEACEÆ—(concluded)		
75	Leskea Wallichii [Hypnum]	.	On trees, May. Askot
76	„ assimilis, Mitten	...	.
77	„ haplohymenium [Hypnum]	.	..
78	„ cymbifolia	.	Common, May.
	TRIBE MNIACEÆ		
79	Fissidens sylvaticus	...	.
80	„ viridulus	.	...
81	Mnium rhynchophorum	..	Common, summer
82	„ trichomanes	..	.
83	Mniadelphus humifusus	...	..
	TRIBE HYPOPTERYGIACEÆ.		
84	Cyathophorum intermedium	...	...
	TRIBE POLYTRICHACEÆ.		
85	Atrichum flavisetum	..	..
86	Pogonatum himalayanum, Mitten	...	Resembles arnigerum.
87	„ microstomum	..	„ „
88	„ aloides	...	Ground Binsar, April.
89	„ fuscatum, Mitten	...	„ „ „
90	Polytrichum perichætiale	.	...
91	Lyellia crispa	..	.

CHAPTER VIII.[1]

SCIENTIFIC BOTANY—(*continued*).

CONTENTS.

PLANTS found in Kumaon, Garhwál and the adjoining parts of Tibet by Captain (now General) Richard Strachey and Mr Winterbottom.

THE following extract from Hooker and Thomson's "Introductory Essay[2] to the Flora Indica" regarding the value of General Strachey's and Mr. Winterbottom's botanical work in India appears to be a fitting introduction to the list of plants discovered by them in Kumaon, Garhwál, and in the neighbouring parts of Tibet.

"The collection distributed by Captain Strachey and Mr. Winterbottom consists chiefly of the plants of Kumaon and Garhwál, and of those of the adjacent parts of Tibet. Captain Richard Strachey was appointed by the Indian Government to make a scientific survey of the province of Kumaon, and was occupied on the task about two years, during which time, in addition to the important investigations in physical science which occupied his attention, he thoroughly explored the flora of the province, carefully noting the range of each species. He was joined by Mr. Winterbottom in 1848, and they travelled together in Tibet. Their joint collections, amounting to 2,000 species, were distributed, in 1852-53, to the *Hookerian Herbarium, the British Museum, the Linnæan Society, and* some foreign museums; and the scientific results are now in course of publication. The beautiful preservation of the specimens, and the fullness and accuracy with which they are ticketed, render this herbarium the most valuable for its size that has ever been distributed from India."

The original printed list was put into Mr. Duthie's hands by General Strachey in 1876, shortly before starting for India to take up his duties at the Saháranpur Botanical Gardens. Not having sufficient time to revise the whole of it by an examination of the specimens preserved in the Kew Herbarium, his notes were left behind to be completed by another hand. These notes together with the single copy of the original catalogue were missing for a time. The list however was found, and since then Mr. C. B. Clarke has undertaken to revise it up to the end of the Polypetalæ, as well as the willows, the grasses, and the two families of *Urticaceæ* and *Piperaceæ.* After completing the revision of the polypetalous orders Mr. Clarke remarks, "I may add that the only use of the above verification must be to show how very good the names in the list are; it would be useless to carry it on further, for in the next order (as *Compositæ*) it would be better to name up the Herbarium by the list than to reduce the list by the Herbarium. For unless the order has been specially worked up, as to the Indian plants in the Herbarium, it is not so carefully sorted out as were the Strachey and Winterbottom plants originally."

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[1] The materials for this Chapter were placed at my disposal by Major-General R. Strachey, and have been edited and arranged by Mr. F. Duthie, Curator of the Botanical Gardens, Saharanpur.

[2] Page 65.

The following explanatory notes by the same botanist should also be recorded:—"In the above reduction all that is asserted is that I have seen the ticket of Strachey and Winterbottom copied on the left-hand side of the page, and that when I saw it, it was in the new bundle having the name on the right-hand side: nothing beyond this. As regards the missing tickets, it appears that some of the common plants (as *Nelumbium, &c.*), were never laid in. Secondly, that where there were duplicates of the same plant under several numbers, some of the duplicate numbers were distributed. Thirdly, that some of the fragmentary or critical species were set aside and named in MS. on the sheets, no printed ticket being placed on the sheet, but the name being carried into the printed list. I only discovered this in the beginning of *Leguminosæ,* and have found several of the written-up sheets since. They are among the most important to find; but without printed tickets they can hardly be found in a Herbarium of this size unless they are lighted on by a fortunate accident. Lastly, after these three causes have been allowed for, there are certain plants, as *Mucuna atropurpurea,* which I cannot find anywhere, though I have made a special and long search for them. I can only suppose that *Mucuna atropurpurea* was named on a flowering specimen or fragment that it was considered useless to paste down."

The arrangement of the revised list has been made to correspond with that of the Flora of British India, as far as that work has been completed; the names of many plants have consequently been altered in accordance with the nomenclature adopted in that work. As the reference number of each species in the original catalogue is given in column 2, the old name is not added except in the case of plants now referred to a different genus.

As the reference number of each species in the original catalogue is given in column 2, the old name is not added except in the case of plants now referred to a different genus.

ABBREVIATIONS USED IN THIS LIST

IN COLUMN 3.

H.	for	herb	.	S. or Sh	for	shrub
H. cr	„	creeping herb	.	S. H.	„	herbaceous shrub.
H. fl.	„	floating herb	..	S. P.	„	parasitical shrub.
H. pr	„	prickly herb	.	S. sc.	„	climbing shrub
H. sc	„	climbing herb	.	S. T.	„	arborescent shrub

Herb S. & W. per herbarium of Strachey and Winterbottom.

IN COLUMN 5.

Bl	for	blue	. .	Or.	for	orange	...	Sc	for	scarlet.
Br.	„	brown	. .	Pk	„	pink	...	W.		white,
Gr.	„	green	...	Pr	„	purple	...	Y.		yellow.
Li.	„	lilac	...	R.	„	red.				

List of Kumaon

Name	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant	Colour of flower.	Time of flowering.	Locality.
I.—RANUNCULACEÆ.						
1 Clematis.						
montana, *Ham.* ..	(7)	S. sc	10′—12′	W.	April ...	Naini Tál, &c.,
var. *major* ..	(7½)	S. sc	10′—30′	W.	May ...	Mádhári Pass, &c
barbellata, *Edgew* ...	(5)	S sc	6′	Y Pr.	May ..	Dwáli, Mádhári Pass.
grata, *Wall.* ..	(12)	S sc	10′	Y. Gr.	October .	Almora, &c .
Gouriana, *Roxb.* ...	(9)	S sc	10′	Y Gr.	December,	Kota-dún, Kapkot
puberula, *Hf. & T.* .	(14)	S sc.	10′	Y. Gr.	March ..	Outer hills, Ukhimath
orientalis, *L.* ...	...	...	...	..	...	...
var *acutifolia* ..	(3 & 4)	S. sc.	2′—3′	Pr.	August ...	Milam, Niti Laptel, Gugi
nutans, *Royle* ...	(13)	S sc	10′	Y. Gr.	March ..	Outer hills, Ukhimath
acuminata, *DC.* ...	(1)	S. sc	6′—8′	...	July .	Naini Tál, Binsar
connata, *DC.* ..	(2 & 6)	S sc	6′—8′	W Y	July-August	Naini Tál, Rálam River, &c.
Buchananiana, *DC*	11	S sc	10′	Y Gr	October ..	Almora, &c
grewiaeflora, *DC.* ...	10	S sc.	8′	Y Gr	December,	Thal, &c. ...
2 Anemone.						
albana, *Stev.* ..	..	...	...	.	..	.
rupicola, *Camb.* ...	1	H.	9″	Wh.	June ...	Pindari, Rogila
vitifolia, *Ham* ..	8	H	2′—3′	Wh.	July ..	Naini Tál, &c,
obtusiloba, *Don.* ...	4	H.	9″	Wh Bl	June ..	Námik, Ramni,
var. *Govaniana*, *Wall*,	9	H	3″—6″	Cr Pr	August ...	Bompràs, Rimkim.
rupestris, *Wall* ...	...	...	..	.		...
rivularis, *Ham.* ..	3	H	9″	Wh.	August ...	Rálam ...
var *hispida*, *Wall*	7	H.	1′	Wh.	May .	Naini Tál .
polyanthes, *Don* ..	..	...	...	.	...	...
var *villosa*, *Royle* .	2	H	1′—1½′	Wh	May ...	Pindari, Rogila Rimkim.
narcissiflora, L. ..	...	...	...	...	...	...
tetrasepala, *Royle* ...	..	...	...	.	...	...
elongata, *Don.* ...	5	H	1′—2′	Wh.	June ...	Chechani-khál,

Plants.

Conditions of soil, &c.	Elevation in feet above the sea.	Himalaya.		Tibet.	Remarks
		Rainy.	Dry.		
Forest ..	5,5—7,500	R.	...		
Do. ..	8—10,000	R.	...	..	
Do. ...	8—10,000	R	...	...	
Open bushes ..	4—6,500	R	...	...	
Do. ...	2 5—3,500	R	..	.	
Do. ...	3—4,500	R.	...	. .	
...	..		.	.	
Open ..	11,500—15,000	.	D.	..	
Open bushes ..	3—4,500	R	...	..	
Forest ...	7—8,000	R	. .	...	
Do. ...	7—9,000	R	. .	..	
Open bushes ..	3—6,500	R.	...	...	
Do. ..	4,500	R.			
...	...	..	...	...	Herb. Winterb., Nos. 787, 770.
Rocks ...	10,500—11,000	R.	..	...	
Woods . .	5—7,500	R.	...	...	
Open ...	8—9,000	R.	. .	...	
	13—15,000	...	...	T	
. .	.	..	...	...	Herb. Winterb, No 136.
Do. ...	12,000	R.	. .	...	
Do ...	7—11,000	R	D.	...	
...	.	.	..	...	
Do. ...	10,500—14,000	R	D.	T.	
...	...	...	. .	...	=*A. polyanthes* of Herb. Winterb.
...	...		.	...	Herb. Winterb.
Woods ...	10,000	R.	...	..	

List of Kumaon

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Habit of plant	Colour of flower	Time of flowering.	Locality.
3 Thalictrum.						
elegans, *Wall* ..	3	H	1′	.	June ...	Rálam River ...
platycarpum, *Hf. & T.*	4 & 13	H	½′ to 2′	.	July .	Milam ..
reniforme, *Wall*	10	H.	4′	.	June .	Ralam River ..
pauciflorum, *Royle*	5	H.	2′	.	July	Piti & Gori Rivers
pedunculatum, *Edgew.*,	.	. .	.	. .	.	
alpinum, *L.*				. .	. .	.
var. *acaule* .	2	H.	3″—4″	...	July . .	Pindar, Hoti, Gugé,
„ *microphyllum*.	1	H.	3″—4″	. .	August .	Barjikáng Pass, &c
Punduanum, *Wall.*	9	H	1′—2′	Wh	July .	Naini Tál, &c,
saniculæforme, *D. C.*,	7	H	1′	Wh.	July .	Naini Tál, &c,
javanicum, *Bl* . .	8	H.	2′—4′	Wh.	May .	Dwáli .
foliolosum, *D C.* .	11	H.	4′	W, Pr	July	Naini Tál, &c,
minus, *L.* .	12	H.	2′—3′	...	August ...	Niti, Laptel . .
4. Callianthemum.						
cachemirianum, *Camb*,	1	H	2″	Y Pk.	June .	Pindari, Bomprás.
5. Adonis.						
chrysocyathus, *Hf. & T*	. .	H.	9″	Y	July	Rájhoti .
6. Ranunculus						
aquatilis, *L* .	1	H. fl	1′—2′	Y Wh	August .	Barphu, Gyánima
Cymbalariæ, *Pursh* .	23	H cr.	1″	Y.	September,	Gugé Valleys,
pulchellus, *C. A. Mey.*,	18	H	1½″	Y	August .	Bomprás, Niti Pass
var. ..	19	H	6″—9″	Y	September,	Shángcha &c,
lobatus, *Jacq*	3 & 20	H	2″—3″	Y.	September,	Barphu, Gugé,
hyperboreus *Rottb.* ..	.				.	
var *natans*	22	H	3″	Y	September,	Topidhunga .
„ *radicans* . .	21	H cr	3′	Y	September,	Topidhunga ..
Chærophyllos, *L.* ...	..	..			...	.
affinis, *Br* .	15	H.	6″—12″	Y.	June .	Kulhára ..
hirtellus, *Royle*	4	H	6″	Y	August ..	Barjikang Pass,

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himalaya.* Rainy.	*Himalaya.* Dry.	Tibet.	Remarks.
Open ...	11,000	R	.	...	
Do ...	11,500	...	D.	.	
Woods ..	8—10,000	R	..		= *Thalictrum No* 10, in Herb S. & W
On rocks .	7,500	R	..		
...	. .	.	.		Herb. Winterb No. 53.
...	..	...	.	.	
Open . .	12,500—15,000	R	D	T	= *T. alpinum*, & No 793, Herb. Winterb.
Do ..	11—15,000	R.	.	. .	
Banks .	4—8,000	R.	..	...	
On trees .	7—8,000	R	...	..	
Woods ..	8,000	R		.	
Open	3—7,000	R		...	
Do. .	9—15,000	...	D	T.	
Do. . .	12,500—14,500	R.	D.	...	
Wet, open ...	15,500	.	. .	T.	= *A. pyrenaica* and *Trollius* No. 2 in Herb S & W.
Ponds ...	11,500—15,500	. .	D.	T.	
Near water ...	14—15,000	..	..	T	
Open ..	14—17,000		D	T	
In water ..	14—15,000	.	.	T.	
Open ...	11,500—15,000	.	D.	T.	
...	. .		...	.	
Do. ...	14—15,000	...	.	T.	
Do. ..	14—15,000	...	..	T.	
...	...	...	..	..	Herb Winterb. 730.
Do. .	11,000	. .	. .	...	
Do. . .	14,700	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant	Colour of flower.	Time of flowering	Locality.
hirtellus *var.* ..	5	II.	1″—1½″	Y.	June ..	Kalhára ..
„ ..	6	II	4″—6″	Y	June	Láhur .
„ .	8 & 9	II	2″	Y	June .	Kálam, Pindari Valley
„ ...	16	II	3″—4″	Y	August .	Bompiás ..
„ ...	17	II	2″	Y	August	Bompiás .
sceleratus, *L.* .	13	II.	2′	Y.	February,	Plains, Almora,
diffusus, *D.C* ..	.	..	..	..	..	..
var. *mollis* .	10	II	3″—6″	Y.	June ..	Láhur, Chami Pass
„ *obtectus* .	11	II	1′—2′	Y.	June	Jágesar, &c ..
lætus, *Wall.* ...	12	II.	2′—3′	Y	February,	Common ..
flaccidus, *Hf. & T.*,	2	II	½″—1″	Y.	May	Láhur ...
arvensis, *L.* ...	14	II.	1′—1½′	Y	February,	Almora, &c. ..
7 Oxygraphis.						
glacialis, *Bunge* ...	1	II	3″	Y.	July .	Barjikáng Pass
polypetala, *Hf. & T.*,	2	II	3″	Y.	May	Champwa, &c.
8 Caltha.						
palustris, *L.* ..	..	..	...	...	...	..
var. *Govaniana* ..	1	II	6″—15″	Y	May ..	Mádhári Pass,
„ *Himalensis* ...	2	II	2′—3′	Y	May .	Jhuni ..
9. Trollius.						
acaulis, *Lindl.* ..	1	II.	6″	Y.	June ..	Pindari, Kulhara.
pumilus, *Don.* ..	2	II	1′—2′	Y	August ..	Barjikáng Pass.
10 Isopyrum.						
grandiflorum, *Fisch*,	2	II.	3″—6″	Bl. Or.	July ...	Níti, Topidhunga
var. *microphyllum*...	1	II.	3″—6″	Bl. Or.	June .	Pindári, &c. ..
11 Aquilegia.						
vulgaris, *L.* ...	..	...	...	...	...	...
var. *pubiflora* ..	2	II	1′—2′	Pr.	July ..	Naini Tál ...
„ *pyrenaica* ...	1	H.	2′	Fr.	June ..	Pathakori ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya*		Tibet	Remarks.
		Rainy.	Dry		
Open	10,000	R		...	
Wet	9,500	R		.	
Open	11,000	R	...	..	
Do	14,500	R	. .	.	
Do	14,500	R.		...	
Fields	1—1,500	R	.	..	
	..			.	
Open	7,500—10,000	R.	..	...	
Do.	6—9,000	R	..	..	
Do	3—7,000	R	...	...	
Wet	10,000	R	.	..	
Fields	5,000	R	..	...	
Open	14,500	R	..	...	
Do.	12,000	R	..	...	=*Callianthemum* No. 2 in Herb S. and W.
...	..	...	. .	...	
Wet, open	9,000	R	..	..	
Do.	8,500	R.	.	...	
Open	11—12,000	R	..	...	
Do.	13,000	R.	.	...	
On rocks	11,500—15,500	..	D	T.	
Do.	11—13,000	R	..	...	
...	.		. .	...	
Woods	7,500	R.	...	...	
Open	10,500	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth	Height of plant	Colour of flower.	Time of flowering	Locality.
12. Delphinium.						
denudatum, *Wall.* ..	3	H.	2'—3"	Bl.	June ..	Naini Tál, &c.,
cœruleum, *Jacq.* ...	10—18	H.	3"—2" 2"—3"	Bl	August .	Laptel, Niti, Gugé.
elatum, *Wall.* ..	..	...	...	.	..	..
var *ranunculifolium* .	2	H	3'	Pr.	August ..	Rálam River
vestitum, *Wall* ..	7	H.	1'	Gy	August	Tola ..
cashmirianum, *Wall.*,	5	H.	1'	Gy	August .	Barjikáng Pass,
var	6	H.	2'	Bl	September,	Pindari . .
Brunonianum, *Royle*	4	H.	2'	Bl.	August .	Barjikáng Pass,
13 Aconitum.						
Lycoctonum, *L.* ..	4	H	3'	Bl	May ..	Mádhári Pass,
ferox, *Wall.* ...	3	H.	3'—4'	Bl	August ..	Barjikáng Pass, Pindári
Napellus, *L.* ..	5	H	6"—8"	Bl.	August .	Barjikáng Pass,
var. *multifidum* ...	2	H	6"—12"	Bl	September	Leptel, Milam,
heterophyllum, *Wall.*,	1	H.	2'	Bl.	July .	Pindari, Milam,
14 Actæa.						
spicata, *L.*	...	H	2'	Wh.	May ..	Kulhára ..
15. Pæonia.						
emodi, *Wall.* ...	...	H	2'—3'	Wh	May ..	Naini Tál, &c
II.—MAGNOLIACEÆ						
1. Michelia.						
Kisopa, *Ham.* ...	...	T	50'	Wh.	May ..	Gagar ...
III.—MENISPERMACEÆ						
1. Cocculus						
laurifolius, *D. C.* ...	1	T	20'	Gr	March ...	Outer hills, Almora.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himá-laya.*		Tibet	Remarks.
		Rainy	Dry		
Open ..	5—7,500	R.	.	.	
Do. .	12—15,500	.	D	T	
...	.	..		...	
Do. ..	9,500	R		..	
Do. .	11,500		D.	.	
Do. ..	12—15,000	R.	D	...	
Do. .	12,000	R	..	...	
Do ..	14,700	R	..	...	
Near water in woods.	8—9,500	R.	...	...	
Open ..	12—13,500	R	D	...	
Do ..	13,500	R	...	...	
Do ..	12,500—15,000		D	T.	
Do. ..	12—13,000	R	D	...	
Shady woods ...	9—11,000	R.	...	...	
Woods ...	5—8,000	R.	...	...	
Forest ..	6—7,000	R.	...	...	
Open woods ...	1—5,000	R.	...	...	

Name	Herbarium number (Strachey and Winterbottom)	Habit of plant	Height of growth	Colour of flower.	Time of flowering.	Locality.
2 Stephania.						
hernandifolia, *Walp.*	3	H. sc	...	..	...	?
elegans, *Hf. & T.*	2	H sc	2′—3′	Pk	June	Kathi, &c.,
rotunda, *L.*	1	H sc	10′	Gr. Y.	May	Bágesar
3 Cissampelos.						
Pareira, *L*	...	S sc.	6′—8′	Gr Y.	May	Almora, Bágesar
IV.—BERBERIDACEÆ.						
1. Holbællia.						
latifolia, *Wall.*	1	S sc	15′	Pr	April	Shámket, &c.,
var. *angustifolia*	2	S sc	15′—20′	...	...	Binsar
2. Berberis.						
nepalensis, *Spreng*	1	Sh.	6′	Y	February,	Binsar, &c
vulgaris, *L.*	...	..	...	...	...	
var. *cretica*	11	Sh	5′	Y.	May	Pindari, Bampa
umbellata, *Wall*	10	Sh	10″	Y	May	Dwáli
aristata, *D. C.*	2 & 5	Sh	8′—12′	Y	April-May	Binsar, Naini Tál, Dudatoli
var. *floribunda*	3,4 & 8	Sh.	10′—12′	Y.	May	Dwáli, Námik,
Lycium, *Royle*	7	Sh	6′—10′	Y.	April	Razi, Nandáki River.
asiatica, *Roxb.*	6	Sh	6′	Y	April	Almora, &c.
concinna, *H. f*	...	...	...	...	...	...
var	9	Sh.	1½′	Y	May	Razi
3. Podophyllum.						
emodi, *Wall.*	...	H.	1′—2′	W.	May	Pindari
V.—NYMPHÆACEÆ						
1 Nelumbium.						
speciosum, *Willd*	...	H	...	W.	August	Bhím Tál

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himá-laya*		Tibet	Remarks.
		Rainy.	Dry.		
...	5,000?	R	...	...	
Open	6—7,500	R	..	..	
Forest	3,000	R	...	...	
Open	3—6,000	R	...	...	
Open woods	5—7,500	R	...	...	
Forest	7,000	R.	...	...	
Woods	6—8,000	R	...	...	
...		. .	...	..	
Open	10—11,000	R.	D.	...	
Do.	9—10,000	R	...	...	
Do	6,500—10,000	R	...	...	
Do.	8—10,000	R.	...	...	
Do.	8,5—9,500	R	...	...	
Do	2,5—7,500	R.	...	...	
...		.	...	...	
Woods	9,500	R.	...	...	
Open	10,500	R.	...	...	
In water	4—5,000	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom.)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
VI.—PAPAVERACEÆ.						
1. Papaver.						
dubium, *L.* ...	...	..	..	...	...	...
var. *lævigatum* ...	1	II.	1′—2′	R	March ..	Almora ..
somniferum, *L.* .	2	II	1½′	W.	February,	Outer hills ..
2. Argemone.						
mexicana, *L.* ...	4	II.	2′	Y.	February,	Plains, Bhábar.
3. Meconopsis.						
aculeata, *Royle* ..	2	II.	1′—1½′	Bl.	July ..	Barjikáng, Níti,
robusta, *Hf & T.* ..	1	II.	2′	...	August ...	Námik ..
4. Stylophorum.						
lactucoides, *Benth. & Hook*	...	II.	9″	Y.	June ...	Rogila ..
VII.—FUMARIACEÆ.						
1 Dicentra.						
scandens, *Walp.* ..	...	II	3′—4′	Y	August ...	Júgesar below Binsar.
2 Corydalis.						
rutæfolia, *Sibth.* ...	7	II.	6″	Y.	June ...	Dwáli ..
cashmiriana, *Royle* ...	2	II.	3″	Bl.	May ..	Mádhári Pass,
elegans, *Wall* ..	6	II.	9″	Y.	August ...	Barjikang Pass,
Goványana, *Wall.* ..	3	II.	9″	Y.	May ..	Champwa ...
tibetica, *Hf & T.* ...	16	II.	3″	Y.	August ...	Lanjar ...
Moorcroftiana, *Wall* ..	4	II.	1′—1½′	Y.	July	Rimkim ...
Gortschakovii, *Schrenk*	12	II	1½′—2′	Y	September,	Kyungar ...
ramosa, *Wall.* ...	9	II.	1′—1½′	Y.	July ...	..
var. *vaginans* ...	10	II.	1′—2′	Y	August ...	Rálam, Níti ..
„ *nana* ..	13, 14, 17	II.	3″—4″	Y.	August,	Barjikáng Pass, Kala jawar ..
cornuta, *Royle* ...	8	II.	2′—3′	Y	July ...	Chaur, Káimandi Pass.
chærophylla, *DC* ...	1	II.	1′—2′	Y	June ...	Binsar ...
meifolia, *Wall.* ...	5	II.	1′—1½′	X	...	?
flabellata, *Edgew.* ...	15	II.	2′—3′	Y.	August ...	Níti ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himá-laya*		Tibet	Remarks
		Rainy	Dry		
...	..	..	..	...	
Fields ..	1—5,500	R.	...	...	
Cultivated ...	14,000	R.	...	...	
Open naturalized	1,000	R	...	...	
Open ...	11—12,500	R	D	...	
Do ...	8,000	R.	...	..	
Do. ...	11,000	R	...	...	= *Dicranostigma lactucoides*. In Herb. S. & W.
Shade ...	5—7,000	R.	...	...	
Woods ...	8,500	R.	...	...	
Open .	10—12,000	R.	...	...	
Do ..	13,500	R	...	...	
Do ..	12,000	R.	...	..	
Do. ..	17,000	...	...	T.	
Do ..	15,500—16,000	...	...	T.	
Do ...	15,000	..	...	T.	
Do. ..	10,000 ?	R.	...	...	
Do ..	11—12,000	R	D.	...	
} Do. ..	14—15,000	R.	D.	...	
Woods ..	6—8,000	R.	-	...	
Rocks ..	7—8,000	R.	...	...	
Open ...	10,000?	R.	...	...	
Do. ...	9—11,500	...	D.	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant	Colour of flower.	Time of flowering.	Locality.
3. Fumaria						
parviflora, *Lam.* ..	...		..	..	...	...
var *Vaillantii* ..	...	II.	6″—12″	R.	January .	Plains, Almora,
VIII.—CRUCIFERÆ						
1 Parrya						
macrocarpa, *Br.*	1	II	.		August .	Gugé ...
lanuginosa, *H. f. & T.*,	2	II	2″—3″	?	September,	Lanjar ..
2. Cheiranthus						
himalayensis, *Camb* .	...	II	3″	P.	July ..	Unta-dhúra, &c
3. Nasturtium.						
officinale *Br.* ..	2	II	6″	Wh.	June ...	Almora, &c.
indicum, *DC.* ..	1	II.	1′—2′	?	March ..	Outer hills ...
4. Barbarea.						
vulgaris, *Br* ...	...	II.	1′	Wh	August .	Rálam ...
5. Arabis						
glabra, *Crantz* ..	...	...	.	...	...	...
alpina, *L* ...	14—15	II.	1′—2′	Wh	August ..	Niti ...
amplexicaulis, *Edgew*,	1, 2 & 3	II	0″—18′	W Pk	May ..	Nádhári Pass,
6 Cardamine.						
hirsuta, *L.* ...	3 & 8	II	1′	Wh	March ...	Almora ..
impatiens, *L* ...	9	II	1′—2′	Wh	March ..	Outer hills ..
macrophylla, *Willd.* } var. *foliosa*	1, 2, & 4	II.	1′—3′	Pk. W. Y.	{ June-July,	{ Námik, Kulhára Sing-jaii Naini Tál ...
7. Alyssum.						
canescens, *DC* ...	...	II.	2″	...	July ...	Tisum ...
8. Draba.						
alpina, *L.* ...	2, 7	II	1″	Y.	August ...	Kyungar, Balji káng Pass.
incana, *L.* ..	8, 9	II.	2″—8″	Wh.	August ...	Níti, Gugé, Rinkim
lasiophylla, *Royle* ..	1	II.	1″—4″	Wh.	July ...	Milam, Gugé .

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the area.	Himalaya. Rainy.	Himalaya. Dry.	Tibet.	Remarks.
...	...	..	...	...	
Fields ..	1—5,500	R	...	...	
Open ...	14—15,000	...	...	T	
Do. ..	17,500	...	...	T.	
Do. ..	16—17,000	..	D.	T.	
Water ..	1—12,000	R	...	..	
Open ..	1—6,000	R	...	...	
Do ..	6 –12,000	R	...	...	
...	...	...	..	...	= *Cruciferæ ignotæ* No 10 in Herb. S & W.
Open ..	11,500	..	D	...	= *Cruciferæ ignotæ* Nos. 11 and 12 in Herb. S. & W
Wet ..	8—10,000	R	...	...	= *Cardamine* No 5 in Herb S & W.
Open ...	5—6,000	R.	...	...	= *Cardamine* No. 3 in Herb S & W.
Do ...	5—7,000	R	...	..	
Wet ...	6—10,000	R	.	...	= *Arabis* No 5 in Herb. S. & W.
Open ...	15,000	...	...	T	= *Draba* No. 5 in Herb. S. & W.
Do. ...	14—16,000	R.	D	T.	No 2 in part Herb. S. & W
Do ..	11,500—15,500	...	D.	T	
Do ...	15 - 16,500	...	D	T.	= No 2 (partly] Herb. S & W.

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower	Time of flowering.	Locality.
9. Cochlearia.						
scapiflora, *H. f. & T.*,	...	H.	2"	Wh	August ...	Gugé ...
10 Sisymbrium.						
mollissimum, *C. A. Mey.*	3	H	4"—8"	Pk	July .	Rimkim ..
himalaicum, *H. f. & T.*	7	H	6"	Pk	August ..	Milam ...
Thalianum, *Gay & Monn*	8	H	½'—1'	Wh	March ..	Almora ..
rupestre, *Edgew.* ...	6	H	1'—2'	Pk	August	Ralam ..
strictum, *H. f. & T.* ...	5	H.	1'	...	July .	Garhwál ..
Wallichii, *H. f. & T.* ...	9	H	1'—2'	Pr	March ...	Almora ..
Sophia, *L.* ..	2	H	2' 3'	Y	May ...	Almora ...
Columnæ, *Jacq.* ..	4	H	2'—3'	...	July ..	Rimkim .
Alliaria, *Scop* ..	1	H.	2'	Wh.	May ..	Almora ..
11. Eutrema.						
primularæfolium, *H. f. & T.*	...	H.	4"—6"	Pr.	May ..	Mádhári Pass,
12. Erysimum.						
hieraciifolium, *L.* ..	1	H.	1'—2'	Y	July ..	Rimkim, Joshimáth.
Sp ...	2	H.	1"	Y.	August	Gugé ..
13. Christolea						
crassifolia, *Camb.* ..	...	H	1'	...	July ..	Sattag river in Guge
14 Braya.						
rosea, *Bunge* ..	...	H.	2"—4"	Wh	July ...	Sangta-deo, Gugé.
15 Brassica.						
nigra, *Koch.* ...	...	H	1'—3'	Y.	March ..	Almora, &c
campestris, *L* ...	...	H	1'—3'	Y.	March ...	Almora, Milam,
juncea, *H. f. & T.* ...	...	H.	1'—3'	Y.	March .	Almora, &c. ..
16. Eruca.						
sativa, *Lam.* ..	...	H.	1½'	Wh.	May ...	Almora, &c. ..

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya.*		Tibet	Remarks.
		Rainy.	Dry		
Open	15,500	...	.	T	
Do	13,500	...		T.	= *Arabis* No 10 Herb S. & W
Do	13,000	..	D	.	= *Arabis* No 8 and *Crucif. Ignot.* No. 14, Herb S. & W.
Fields	5—6,000	R	...	...	
Open	12,000	R	...	..	= *Arabis* Nos 7 & 9, Herb S. & W.
Do.	6—[illegible],000	R	..	. .	= *Crucifer. Ignot.* No 5 Herb S. & W.
Fields	5—6,000	R	...	.	
Do	5—6,000	R	..		
Open	13,500		...	T	= *Crucifer. Ignot.* No. 1 Herb. S & W
Fields	5—6,000	R.	..	...	
Rocks	9—10,000	R	..	..	= *Arabis* No. 6 in Herb. S & W.
Open	6—14,000	R.	D	T	
Do.	15,500	..	..	T	
Do.	13,500	...	..	T.	
Do.	10—16,500	R	D	T	= *Draba* Nos 3 & 13 Herb S. & W.
Cultivated	1—6,000	R	.	..	= *Sinapis* No 5 Herb. S & W.
Do.	5—11,000	R.	D	...	= *Sinapis* Nos. 2, 3 and 6 Herb. S & W.
Do.	1—6,000	R.	...	...	= *Sinapis* Nos. 1 and 4 Herb. S. and W.
Do	1—6,000	R	...	...	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower	Time of flowering.	Locality.
17 Capsella						
Bursa-pastoris, *Mœnch*	...	H	1′–2′	Wh	All the year	Ubique ..
Thomsoni, *H. f.* ...	...	...	.	...	..	...
18. Lepidium						
Sativum, *L.*	1	H.	1′			Almora ..
capitatum, *H. f. & T.*,	2	H	4″	Wh.	August .	Milam, Topidhunga
19. Megacarpæa						
polyandra *Benth.* ..	...	H	5′ - 6′	Wh	May ..	Champwa, Pindari,
20 Thlaspi						
arvense, *L* ..	3	H.	1″	Wh	July ...	Almora ..
alpestre, *L.* ..	1, 2	H.	6″	Wh.	June .	Rajhoti ...
21. Iberidella.						
Andersoni, *H f. & T.*	...	H.	2″ - 4″	Wh.	July ...	Sagta-deo, Gugé.
22 Crambe.						
cordifolia, *Stev* .	...	H	4′–5′	Wh	July ..	Rimkim ..
23. Raphanus						
sativus, *L.* ..	...	H	1′	...	March ..	Plains to Almora
24 Chorispora						
sabulosa, *Camb.* ..	...	H.	3′	...	July ...	Rimkim ...
IX.-CAPPARIDEÆ						
1. Cleome.						
viscosa, *L.* ...	..	H	3′–4′	Y.	August ..	Sarju river, outer hills.
2. Capparis.						
horrida, *L.* ..	...	Sh.	10′	W Gr.	March ...	Bhábar ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himalaya*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	5—12,000	R	...	.	
...	..	..	...		Herb Strachey No 15.
Fields ...	5 6,000	R			
Open ...	13—15,000	R	D.	T.	
Do. ...	12,000	R	...	...	=*Crucif ignot.* No 15 in Herb. S and W.
Fields ...	5—6,000	R.	...		
Open ..	15,000	..	.	T	
Open ...	10—16,500	R.	D.	T.	=*Draba* Nos. 3, 4, 11, 12, in Herb. S and W
Do ..	14,000	...	..	T.	=*Crucif ignot.* No. 4 in Herb. S. and W.
Cultivated ...	1—6,000	R	..	...	
Open ..	13,500	...	...	T.	
Do. ...	2—3,000	R	...	...	=*Polanisia viscosa* in. Herb. S. and W.
Forest ...	1—2,000	R.	...	...	

List of Kumaon

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant	Colour of flower.	Time of flowering.	Locality.
X.—VIOLACEÆ.						
1. Viola.						
biflora, *L.* ..	1	H.	3"	Y	May ..	Naini Tál, &c.,
Patrini, *DC.* ...	3, 4, 10	H.	2"—5"	Bl	March-July	Outer hills, Rampa.
serpens, *Wall* ...	5, 6, 7, 8, 9, 11.	H.	2"—6"	Bl W.	March-June.	Sawangentha, Almora, Naini Tál, &c.,
kunawarensis, *Royle*,	2	H	1"—2"	Bl	July ..	Kyungai ..
XI.—BIXINEÆ						
1. Flacourtia.						
Ramontchi, *L'Herit.*...	...	...		...	..	...
var *occidentalis*	...	T.	25'	.	February,	Bhábar ..
XII.—PITTOSPOREÆ		.				
1 Pittosporum.						
floribundum, *W. & A.*,	1	T.	...	...	..	Bhábar ..
eriocarpum, *Royle* ...	2	T.	20'—30'	...	April ...	Outer hills ...
XIII.—POLYGALACEÆ						
1. Polygala.						
triphylla, *Ham.* ...	1	H.	2"—3"	R.	August ..	Páton .
var glaucescens .	2	H	3"—4"	Y	August ..	Ramari ..
crotalarioides, *Ham.*	7	H.	6"—12"	Pk.	May ..	Almora, &c.
abyssinica, *Fresen.* ..	6	H.	12"—15"	Pk	April ..	Kapkot, outer hills.
persicariæfolia, *DC.*,	4	H.	6"	Pk	July ...	Jágesar ...
chinensis, *L.* ..	3	H	6"	Y Gr.	July ...	Almora ..
sibirica, *L.* ...	5	H,	6"	Pk.	May ...	Kosi river ..
XIV.—CARYOPHYLLACEÆ.						
1. Gypsophila.						
cerastioides, *Don.* ...	1	H.	2"	Pk.	August ...	Námik, Rálam,
2 Saponaria						
Vaccaria, *L.* ...	...	H.	2'—3'	Pk.	March ..	Outer hills ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	Himalaya.		Tibet.	Remarks
		Rainy.	Dry.		
Open wet ...	8 13,500	R	D	...	
Banks, & rocks,	4—11,000	R	D,	.	
Do. ...	3—11,000	R	D	..	
Open wet ...	15,500	.	.	T.	
Forest ...	1—2,500	R	..	...	=*F. sapida*, in Herb S. & W.
Forest ...	1—2,000	R	...	...	
Open ...	4,000	R	...	...	
Do ...	6,000	R	..	...	
Do. ...	4,500	R.	...	..	
Do. ..	4—7,000	R	..	..	
Do. ...	2,5—4,000	R	..	...	
Do ..	6—6,500	R.	...	.	
Do. ..	4,000	R	..	...	
Do. ...	6,000	R.	...	..	
...	8—12,000	R.	.	...	
Fields ...	1—4,000	R.	...	...	=*Vaccaria parviflora*, Mœnch & Silene No. 9 in Herb. S. & W.

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
3. Silene.						
inflata, *Sm* ..	1	H	1′—2′	Wh.	June ..	Outer hills, Milam, Niti
conoidea, *L* .	2	H.	1′—2′	Pk.	March ...	Almora
Moorcroftiana *Wall*,	4, 10	H.	6″—9″	Pk	August ..	Gothing, Rákas tál
Falconeriana, *Benth*,	5	H.	3′	Gr. Y	July ..	Almora .
Griffithii, *Boiss*	7	H	2′	Wh	July ...	Bampa .
Stracheyi, *Edgew* ..	8	H.	3′	Wh.	August ..	Piti river ..
4 Lychnis.						
apetala, *L*	4,6	H	4″—7″	Wh.	July	Rálam, Gugé
macrorhiza, *Royle* ..	3	H	4″	Wh.	September,	Topidhunga, Llanjar
brachypetala, *Hort.* ..	5	H	8″	Wh.	July ..	Laptel, Rálam,
indica, *Benth.* ..	...		...	..	...	..
var. *fimbriata* ...	1	H.	3′	W Pi	August .	Piti river ..
pilosa, *Edgew.* ..	2	H	1′—2′	Wh	August, September.	Rálam, Tungnath.
5 Cerastium.						
vulgatum, *L.* ...	2	H	4″	Wh	May ..	Almora, &c ..
Thomsoni, *Hook. f*	1	H	4″	Wh.	May ...	Mádhári valley,
6 Stellaria.						
paniculata, *Edgew.* ...	1, 2 & 3	H	1′—3′	Wh	May, July, September,	Binsar, Shaudevi.
media, *L.* ..	7	H.	6″—12″	Wh	All the year	Outer hills, &c,
semivestita, *Edgew* .	9	H	1′	Wh.	May ..	Chaur ..
Webbiana, *Wall* .	...	H.	3″—4″	Wh.	March ..	Almora ..
latifolia, *Benth* ...	...	H	4″	Wh.	August ..	China, Naini Tál.
longissima, *Wall.* ..	5	H	1′—2′	Wh.	May .	Mádhári Pass, Naini Tál.
uliginosa, *L* .	8	H	1″—6″	Wh	March ..	Almora, Barjikáng Pass.
decumbens, *Edgew.* ...	6	H	5″	Wh.	August ..	Milam, Rálam,

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himálaya* Rainy	*Himálaya* Dry	Tibet.	Remarks.
Do. ...	5—11,500	R	D	.	
Do. ...	5—6,000	R	...		
Open ..	11—15,000	...	D.	T	
Do. ..	4—6,000	R	.	...	
Do. ..	11,000		D.	.	
near water ..	7,500	R	..	...	= *Melandrium pilosum* in Herb, S. and W
Open ..	12—15,000	R	D	T	
Do. .	15—17,000		D.	T.	
Do ..	12 -14,500	R.	D.	...	= *Melandrium pilosum* in Herb, S & W.
...	.		...	.	
Do. ..	7—8,000	R	..	...	
Rocks, open	9 12,000	R		...	
Open .	5—7,500	R	..	...	
Do. ..	10,000	R.	..	.	
Woods ..	7—8,000	R.			
Do ..	1—6,000	R		..	
Wet ..	6,000	R	...	...	
Open ..	4—6,000	R	..	..	= *Leucostemma* No. 2 in Herb S. and W
Rocks ..	6 - 8,000	R	...	..	= *Leucostemma* No. 1 in Herb S. and W.
Open ..	6—9,000	R.	..	..	
Wet ...	4—13,000	R	..	...	
Open ...	12—13,500	R	D.	...	= *Arenaria* No 9 in Herb S. & W.

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth	Height of plant	Colour of flower	Time of flowering	Locality
7. Arenaria.						
foliosa, *Royle* ...	...	H	2″	Wh.	June ...	Jolum
festucoides, *Benth.* .	2	H.	3″	Wh.	August .	Pindari, Kaináli river
var. *imbricata* ...	3	H.	2″—3″	Wh	Ditto .	Bálam
musciformis, *Wall* ...	1	H	1″	Wh	Ditto ..	Balchha Pass ..
serpyllifolia, *L.* ...	10	H	4″	Wh.	Ditto ...	Jelum, Milum .
glanduligera, *Edgew.* .	13	H.	1″	Wh.	Ditto ..	Barjikang, Chorhoti Pass.
Stracheyi, *Edgew* ..	...	..	...	...	...	
holosteoides, *Edgew.* ..	...	H	2″	...	September,	Rákas-Tál ..
8 Sagina.						
procumbens, *L* ...	..	...	.	...	..	.
var. *pentamera* ...	2	H.	1″—1½″	...	June ..	Jelum, Singjari,
9. Thylacospermum						
rupifragum, *Schrenk*,	...	H	1″ - 2″	Wh.	July ..	Gugé ..
10 Spergula						
pentandra, *L.* ...	...	H	4″—6″	Wh	...	Bhábar ...
11 Drymaria						
cordata, *Willd.*	...	H. or	6″	...	February.	Kota Dun ...
12 Polycarpæa						
corymbosa, *Lam.*	...	H.	6″—9″	Wh.	July ..	Almora ..
XIV.—PORTULACEÆ.						
1. Portulaca.						
oleracea, *L.*	...	H	6″	Y	July ...	Do ...

Plants—(continued).

Condition of soil, &c.	Elevation in feet above the sea	*Himálaya*		Tibet.	Remarks.
		Rainy	Dry.		
Open ..	9,000	..	D.		=*Alsine Roylei* in Herb S. and W
Do. ..	10—15,500	R	D.	T	
Do. ..	12,000	R	...		
Do. ..	15—16,500	..		T.	
Do ..	9—11,500		D.		
Do ...	14—16,500	R	D	...	
Do ..	15,000	..	..	...	=*Gypsophila* No. 3 in Herb S & W.
Do ..	9—10,000	R.	D	...	
Do ..	15—16,500	...	...	T	
Do. ...	1—2,000	R	..	...	
By water ...	2,000	R.	..	...	
In fields ...	5,500	R.	...	...	
Do. ..	5,500	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant	Colour of flower.	Time of flowering	Locality
XV.—TAMARISCINEÆ.						
1. Tamarisc.						
dioica, *Roxb*	...	Sh	6′—10′	...	...	Kosi and Ganges rivers.
2 Myricaria						
elegans, *Royle.*	1	Sh	6′	Wh Pk	June ..	Niti, Satlaj river in Gugé
germanica, *Desv.*	2	Sh	3′	Wh. Pk	June ..	Pindari, Milam, Tisum.
XV*—HYPERICINEÆ.						
1 Hypericum						
cernuum, *Roxb* ...	6	Sh	4′—6′	Y	February,	Almora, &c. ...
cordifolium, *Chois* ...	5	Sh	3′	Y.	August	Rámári
patulum, *Thunb* ..	4	Sh.	4′	Y.	July ...	Almora, &c ...
perforatum, *L* ...	7	Sh	6″	Y.	July .	Naini Tál
elodeoides, *Chois.* .	1, 2	Sh.	1′—4′	Y.	July ..	Jagesar, Rálam, Almora,
nepalense, *Chois.* ..	3	Sh	1′	Y	July .	Kalámundi
japonicum, *Thunb*	8	Sh.	6″	Y	July .	Almora, &c. .
XVI.—TERNSTRŒMIACEÆ						
1. Eurya.						
acuminata, *D. C.* ..	...	Tr	25′	Wh.	March ..	Naini Tál, &c
2 Actinidia.						
callosa, *Lindl.* ...	..	S sc	30′—40′	Wh	May .	Outer hills, Kapkot
3. Saurauja						
nepalensis, *D C.* .	...	Tr.	10′	Pk	November,	Outer hills, &c ,
XVII.—DIPTEROCARPEÆ.						
1. Shorea.						
robusta, *Gartn* ...	...	Tr	60′—80′	...	April ...	Outer hills ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himá-laya*		Tibet	Remarks
		Rainy.	Dry.		
River beds	1—1,500	R	...	...	
Open river beds	11—13,500	...	D	T	
Do.	11—15,000	R	D.	T.	
Do	3—6,000	R	...	...	
Do.	4,500	R	...	...	
Do.	3—6,000	R	...	...	
Do.	6,000	R.	...	...	
Do.	5—11,000	R.	...	...	
Banks	8,700	R.	...	...	
Open	4—6,000	R	...	...	
Woods	3—8,000	R.	...	...	
Forest	2—3,500	R.	...	...	
Forest	3—5,000	R	...	...	
Forest	1—2,000	R.	...	...	= *Vatica robusta*, in Herb. S. and W.

List of Kumaon

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower	Time of flower.	Locality.
XVIII.—MALVACEÆ						
1. Malva.						
verticillata, *L.* ..	2	H	1' - 6'	Pr.	August ..	Piti river ..
silvestris, *L* ..	1	H.	1'—2'	Li.	February.	Kota ...
2 Sida.						
humilis, *Willd.* ..	2	H	3'	Or	March ..	Outer hills ..
rhombifolia, *L* ..	3	..	..	...	..	Almora .
cordifolia, *L* ..	1	Sh	3'	Y	...	Almora, Bágesar
3 Abutilon.						
polyandrum, *Schlecht*	2	Sh.	2'—8'	Y Or	August ...	Outer hills, Bágesar.
indicum, *G Don* ..	1	Sh.	6'– 8'	Y.	March ...	Bhábar ...
4. Urena.						
lobata, *L.* ..	...	Sh	4'	Pk.	August ...	Outer hills, Bágesar.
5. Hibiscus.						
radiatus, *Willd.* ..	3	...	5'	Y.	August ...	Below Almora,
Solandra, *L'Herit.* ..	...	H	1'	...	August ...	Háwalbágh ...
vitifolius, *L*	1	Sh	...	Y	August ...	Outer hills ...
pungens, *Roxb* ..	...	H	6'	Y.	August ...	Almora, &c. ...
cancellatus, *Roxb* ...	...	H	3' - 4'	Y.	August ...	Almora, &c ...
6. Thespesia.						
Lampas, *Dalz & Gibs.*	...	Sh.	4'	...	August ..	Bhábar ...
7. Kydia.						
calycina, *Roxb.* ...	...	Tr	20'	...	...	Bágesar, outer hills.

Plants—(continued)

Condition of soil, &c.	Elevation in feet above the sea.	Himalaya		Tibet.	Remarks
		Rainy	Dry		
Open ...	7,500	R.	..	.	
Do ...	2–3,000	R	..	...	
Do ..	4,000	R	..	.	
Do ..	5,000	R	.	...	
Do	3–5,000	R			
Do .	1—4,500	R	...	...	
Do. ..	1,000	R	..	...	
Do. ..	1—3,000	R	..	...	
Do. ..	4,000	R	.	...	
Do. .	4,000	R.	...	...	= *Laguncea lobata* in Herb. S. and W.
...	4,000	R.	...	..	
Do. ...	4–5,000	R.	..	...	= *Abelmoschus* No. 3 in Herb. S. and W
Do. .	3–5,000	R	...	..	= *Abelmoschus* No. 1 in Herb. S. and W.
Forest ..	1—2,000	R	...	..	= *Hibiscus* No. 4 in Herb. S. and W
Do. ...	2–3,000	R.			

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower.	Time of flowering.	Locality.
XIX.—STERCULIACEÆ.						
1. Sterculia.						
villosa, *Roxb.*	1	Tr	20′—30′	...	March	Outer hills
fulgens, *Wall*	..	Tr.	30′—40′	..	March	Bhábar, outer hills.
2 Helicteres.						
Isora, *Wall.*	...	Sh.	5′—6′	...	January	Bhábar
3 Pterospermum						
acerifolium, *Willd*	1	Tr.	30′	...	March	Hardwár
lanceæfolium, *Roxb*	2	Tr	..	...	...	Bhabar
XX.—TILIACEÆ.						
1. Grewia.						
oppositifolia, *Roxb.*	4	Tr	40′	Buff	May	Bhím Tál below,
asiatica, *L*	2	...	...		...	
var *vestita*	5	Tr	20′—30′	Buff	May	Kota, Bágesar,
lævigata, *Vahl.*	1	Sh	15′	...	...	Outer hills
2 Triumfetta.						
pilosa, *Roth*	2, 3	S sc	4′—5′	...	August	Kota, Almora, Bágesar.
rhomboidea, *Jacq*	1	Sh.	1′—1½′	...	August	Háwalbágh
3 Corchorus.						
olitorius, *L*	1	H.	2′	Y	August	Háwalbágh
acutangularis, *Lam*	2	H.	1′—2′	Y.	August	Háwalbágh
XXI.—LINEÆ.						
1. Linum.						
usitatissimum, *L.*	2	H.	2′	Bl	January	Cultivated
2. Reinwardtia.						
trigyna, *Planch.*	...	Sh.	2′—5′	Y.	January	Outer hills

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himálaya.*		Tibet.	Remarks.
		Rainy	Dry.		
Forest	3—4,500	R			
Do	2,500	R.	..	...	= *Firmiana colorata* in Herb S. and W
Do.	1—2,000	R.	...	...	
Do	1,000	R.	..	...	
Do	1,000	R	..	...	
Do.	3,500	R.	...	...	
...	...	..	..	...	
Do	2—3,500	R.	...	...	
Woods	2—3,500	R.	..	...	
Open	2, 5—5,000	...	...	.	
Do.	4,000	R.	...	...	
Do.	4,000	R	..	...	
Do	4,000	R.	...	...	
Fields	1—3,000	R.	...	...	
Open	1—7,000	R.	...	...	

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth	Height of plant	Colour of flower	Time of flowering	Locality
XXII.—MALPHIGHIACEÆ						
1. Hiptage.						
Madablota, *Gærtn*	..	S sc	10'—15'	...	March ..	Outer hills
2. Aspidopteris						
Wallichii, *Hook. f.* ..	1	S sc	10'—15'	..	August ...	Gangoli ..
Sp ...	2	S sc	10'	..	March ..	Almora ..
XXIII.—GERANIACEÆ						
1 Biebersteinia.						
emodi, *Jaub. Spach*	..	H	6"—9"	Y	July ...	Chirchin, &c.
2 Geranium.						
pratense, L. ...	9, 10	H	1'	Pr	June, September	Kulhara, Laptel, Sakh
collinum, *M. Bieb* ..	1	H	4"—8"	Pk.	July ..	Malari, Niti ..
Wallichianum, *Sweet,*	5	H	2'	Pr	July ..	Naini Tal, &c.,
Grevilleanum, *Wall.*	6	H.	3'	Bl	August ..	Ralam, Kulhara,
nepalense, *Sweet* ..	7	H	9"	Pk.	March	Almora ..
rotundifolium, *L*	4	H.	3"	Pk	February,	Ganges valley,
Robertianum, *L* ..	3	H.	1'—2'	Pk	September,	Pandukesar ..
lucidum, *L* ..	2	H	5"—22"	Pk.	March ..	Naini Tal ..
ocellatum, *Camb.* ...	8	H.	1'	Cr	March	Outer hills
3 Oxalis.						
corniculata *L.* ..	1	H	6"	Y.	All the year.	Common ..
Acetosella, *L*	2	H	4"	Wh	March ..	Dwali ..
4 Biophytum						
sensitivum, *DC.* ...	..	H	4"	...	..	Kota Dún

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himalaya*		Tibet	Remarks.
		Rainy	Dry.		
Forest ..	1—3,000	R	...	...	
Open	4,000	R		...	
Do. ..	4,000	R		...	
Open ..	10,500	..	..	T.	
Do ..	10,500—14,000	R	...	T	
Do ...	10,500 —13,000	.	D.	... ...	
Do ...	7—12,000	R	..	...	
Do ..	11,000	R	...	..	
Do ...	4—6,000	R.	...	..	
Do ..	2,000	R	.	...	
Woods ..	6,000	R	.	...	
Do. ...	6,000	R.	..	..	
Shade ..	1,5—1,000	R		...	
Open ..	4—7,000	R	...	...	
Forest ...	7—9,000	R.	...	...	
Shade ...	1,500	R	..	...	

List of Kumaon

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth	Height of plant	Colour of flower.	Time of flowering.	Locality.
5 Impatiens.						
Balsamina, *L* ...	20	H.	1'—2'	Pk.	August ..	Jágesar ...
Thomsoni, *Hook f.* ...	6,7, & 8,	H.	1½"—10"	Pk Y	August ..	Milam, Gothing, Máiam, Niti.
sulcata, *Wall* ...	17	H	8'	Pr.	August ..	Rálam, Kálamundi.
scabrida, *DC.* ...	9, 10	H	2'—3'	Y	August ...	Chiring, Naini Tál
bicornuta, *Wall* ..	4	H	1' 3'	Li	August ...	Kalimundi .
amphorata, *Edgew* ...	11, 13, & 15	H	1'—4'	Li., Pk , Pr	August ..	Molmigári, Gori Valley Naini Tál, &c
racemosa, *DC.* ...	1	H	1'—2'	Y	August ...	Jágesar
laxiflora, *Edgew* ...	2, 3, & 19	H.		Y.	August ..	Naini Tál, Jágesar, Binsar.
glauca, *H f & T.* ...	14	H.	2' 4'	...	August ..	Dwáli ..
XXIV.—RUTACEÆ						
1 Bœnninghausenia						
albiflora, *Reich* .	...	H.	2'—3'	Wh.	June ..	Naini Tál ...
2. Zanthoxylum.						
alatum, *Roxb* ...	2, 3	Sh.	10'	...	March ..	Kartim, Jalat, Bhim Tál.
acanthopodium, *DC.*,	4	Sh	10'	Y G	March ..	Almora, &c .
oxyphyllum, *Edgew*....	...	S sc	10'—20'	Pk.	May .	Káthi, Dwáli, &c.
3 Toddalia.						
aculeata, *Pers* ..	1, 2	S. T.	20'—25'	G. Y.	February,	Bágesar, Bhábar
4 Skimmia.						
Laureola, *Hook f.* ..	...	Sh.	2'—3'	Y.	May ..	Naini Tál, &c,
5 Glycosmis.						
pentaphylla, *Correa* .	...	Sh	4'	...	February,	Kota ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy	Dry		
Open ..	4—5,000	R.		...	
Do ..	11,5—12,500		D.	...	
Do ...	8,5—12,000	..	D	..	
Shady woods ...	5—7,500	R	...	...	
Do. ...	7,000	R	...	..	
Do. ...	4,5—9,500	R.	...	.	
Shade ...	5,—9,000	R	...	...	
Shade ...	6,—7,500	R.	...	..	
Shady woods ..	9,500	R.	.	...	
Woods ..	4—7,000	R	...	...	= *Ruta albiflora* in Herb. S. and W.
Open ...	4—7,000	R.	...	...	
Do. ..	...	R	...	...	
Forest ..	7—8,500	R.	...	...	
Woods ...	1,5,—3,000	R.	...	...	
Forest ...	7,—9,500	R.	...	...	= *Limonia Laureola* in Herb. S. and W.
Do ...	2,000	R.	...	...	

List of Kumaon

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth	Height of plant.	Colour of flower.	Time of flowering	Locality.
6 Muraya.						
exotica, *L.* ..	.	Sh	10'—15'	Wh	March ..	Outer hills .
Koenigii, *Spreng* ..	...	T	20'	...	March ..	Bhábar ..
7 Citrus.						
medica, *L.* ..	1,2	Sh.	10'	Wh	May ..	Powowar, outer hills
8 Ægle.						
Marmelos, *Corr.* ..	...	T	20'	...	...	Bhábar ..
XXV.—SIMARUBACEÆ.						
1 Picrasma.						
quassioides, *Benn.* ..	...	T	20'	..	...	Bandkesar ..
XXVI.—BURSERACEÆ.						
1 Garuga.						
pinnata, *Roxb.* ..	..	T.	40'	..	February,	Bhábar
XXVII.—MELIACEÆ.						
1 Melia.						
Azadirachta, *L* ..	...	T	15'—20'	Li.	March ..	Almora, &c. ...
2. Cedrela.						
Toona, *Roxb* ..	1	T.	30'—60'	Wh	March ...	Kota Dún, &c.
var. *serrata* ..	2	T	20'—40'	Pk.	June ..	Bándani-devi, &c.
XXVIII.—OLACINEÆ.						
1 Olax.						
nana, *Wall.* ...	...	Sh	9"—12"	...	July ..	Damus ...

Plants—(continued)

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya.*			Remarks.
		Rainy.	Dry.	Tibet	
Open ..	2—1,500	R	...	...	
Forest ..	1—2,000	R.	...	...	= *Bergera Kœnigii* in Herb. S. and W.
Woods ..	2—3,000	R.	...	..	
Forest .	1—2,000	R.	..	..	
Open ...	6,5—8,000	R	...	...	
Forest	1,000	R.	...	...	
Gardens .	1—5,000	R.	...	...	
Forest . .	1—3,500	R	...	...	
Do. .	5—7,500	R	...	..	
Open ...	4,500	R.	...	. .	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
XXIX.—ILICINEÆ.						
1 Ilex.						
dipyrena, *Wall.* ..	3	T.	30'—40'	W	April ..	Naini Tal, outer hills.
odorata, *Ham* ..	2	T.	40'	W.	May ..	Do .
excelsa, *Wall*	1	T.	25"	W.	May .	Binsar ..
XXX.—CELASTRINEÆ.						
1. Euonymus						
tingens, *Wall* .	6, 7	Tr	20'—30'	..	April, May,	Naini Tal, Binsar, Mudhari Pass.
fimbriatus, *Wall* ..	4, 5	T or S	10'—30'	...	May .	Dwali, Niti Ghat, &c
echinatus, *Wall.* ..	3	S sc	20'	..	May ..	Dwali, &c ..
pendulus, *Wall.* .	2	T	30'—40'	...	March .	Gagar, &c .
Hamiltonianus, *Wall*	1	Sh	12' 30'	.	.	Almora .
2 Celastrus.						
paniculata, *Willd.* .	2	Sh.	15'	.	...	Bhim Tál .
3 Gymnosporia						
rufa, *Wall* ..	1, 4	Sh.	1'—12'	W. G	March, May,	Sarju Valley, Bageswar.
Royleana, *Wall.* ..	3	Sh.	12'	..	.	Bhim Tal .
4 Elæodendron						
glaucum, *Pers* ..	..	T	20'—30'	...	May ..	Outer hills, Bhim Tal
XXXI.—RHAMNEÆ.						
1 Ventilago.						
calyculata, *Tulasne* ..	...	S sc	20'—30'	..	March ..	Bhabar ..
2. Zizyphus.						
Œnoplia, *Mill.*	2	T		...	..	Rikhikesh ...
rugosa, *Lam* ..	1	T	15'	..	March .	Kota Dun ..

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya* Rainy	*Himálaya* Dry.	Tibet.	Remarks.
Forest	5—9,000	R	...	...	
Do .	3—4,000	R	...	...	
Do ..	4—7,000	R	.	.	
Forest ..	5,5—10,000	R.	...	...	
Do ..	8—11,000	R.	...	...	
Do ...	7—8,000	R.	...	...	
Do ...	6—7,000	R.	...	...	
Open ...	5,000	R	..	...	
Do. ...	4—5,000	R.	...	...	
Forest ...	3,000	R.	...	...	
Open .	4—5,000	R.	...	...	
Forest ...	2—4,500	R.	...	...	
Forest ..	1—2,000	R.	...	..	
Do ..	1—2,000	R.	...	...	
Do. ...	2,000	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower.	Time of flowering	Locality.
3 Berchemia.						
floribunda, *Wall.* ...	...	S sc.	15′	..	..	Almora ...
4 Rhamnus.						
persicus, *Boiss.*	7	Sh	3′	..	June ..	Niti, Milam .
dahuricus, *Pall.* ..	1	Sh	15′	G. Y.	April .	Naini Tal, Bigesar
purpureus, *Edgew.*	4, 5	T.	20′—30′	..	March, April,	Naini Tal, Binsar, Mádhári Pass.
triqueter, *Wall.*	.	T.	15′	.	August ...	Outer hills, Almora.
procumbens, *Edgew*	3	Sh.	4′	...	May ..	Naini Tal, Jagthana
5 Hovenia.						
dulcis, *Thunb.* ...	...	T	40′	Y G	June ..	Bágesar ...
6. Sageretia.						
oppositifolia, *Brongn.*,	...	Sh.	10′—12′	...	August ..	Almora ...
7 Gouania.						
leptostachya, *D C.* ..	2	S. sc.	20′	...	...	Bhábar ...
8 Helinus.						
lanceolatus, *Brand* ..	...	S sc.	10′—12′	...	February,	Kota Dún, &c ,
XXXII.—AMPELIDEÆ.						
1 Vitis						
pallida, *W. and A.* ...	...	S. sc.	...	...	...	..
lanata, *Roxb.* ...	2, 3, 5 & 6	S. sc	6′—20′	...	May, June,	Naini Tál, Almora, Gágar, Namik, Kathi, Dewali-khal.
parvifolia, *Roxb* ...	1	S sc.	10′—15′	...	April ..	Pyura, Almora,
himalayana, *Brand.*...	9	S sc	20′	...	May ..	Madhari Pass, Dhákuri-binaik.
divaricata, *Wall.* ..	8	S sc	10′	...	June ...	Naini Tal, outer hills
capriolata, *Don.* ...	...	S. sc	20′	...	May ...	Naini Tal, Kathi.
lanceolaria, *Roxb.* ..	...	S sc.	20′—30′	...	March ...	Kota Dun, &c.,

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya* Rainy.	*Himálaya* Dry.	Tibet.	Remarks.
Open .	4,500	R	...	...	
Do ...	11,500	...	D.	...	
Forest ...	3—6,500	R	...	..	= *Ceanothus* No 2 in Herb. S. & W.
Do. ...	7—8,000	R.	...	...	
Open ..	5,500	R	...	...	= *Ceanothus* No 1 in Herb. S. & W.
Do. ..	6 7,000	R.	..	..	
Forest ..	3—5,000	R.	...	...	
Open ...	2—5,000	R.	...	.	
Forest ..	1—2,000	R.	...	...	
Open ...	2—3,000	R	..	...	= *Gouania* No. 1 in Herb. S. & W.
..	...	...	...	...	= *Cissus* No 1 in Herb. S & W.
Woods or open,	4,5—7,000	R	...	...	
Open ..	4—6,000	R.	..	...	
Forest ...	7—8,000	R.	...	...	= *Ampelopsis* No. 1 in Herb S. & W
Open ..	3—7,000	R.	...	...	
Forest ..	6—7,500	R.	...	...	= *Ampelopsis* No. 2 in Herb. S. & W.
Do. ..	3,000	R	...	...	= Cissus No. 2 in Herb S. & W.

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth	Height of plant	Colour of flower	Time of flowering.	Locality.
2. Leea.						
aspera, *Wall* ...	...	Sh.	4'—5'	...	June ...	Almora, &c ..
XXXIII.—SAPINDACEÆ						
1 Cardiospermum						
Halicacabum, *L* .	...	H. sc	10'	...	...	Bágesar ...
2 Æsculus.						
indica, *Colebr* .	.	T	10'—81'	Pk. Y	May ...	Dwáli, &c ..
3 Schleichera.						
trijuga, *Willd* ..	..	T	30'	...	...	Bhábar ..
4. Sapindus.						
Mukorossi, *Gærtn.*	...	T	30'	...	...	Bágesar ...
5. Acer.						
oblongum, *Wall* ..	1	T	30'	Gr.	April ..	Naini Tál, &c .
lævigatum, *Wall.* .	2	T	40'	Gr	April .	Gágar, &c ..
cæsium, *Wall.* ..	4	T	50'	Gr	March ..	Dwáli ...
villosum, *Wall.* .	5	T.	50'	Gr	March ...	Mádhári Pass; &c
caudatum, *Wall.* ..	6	T	30'	Gr	March ..	Ditto ...
pictum, *Thunb* .	3	T	30'	Gr	March .	Naini Tál ...
6. Staphylea.						
Emodi, *Wall.* .	...	Sh T	20'	Wh	May .	Gágar, Binsar,
XXXIV.—SABIACEÆ						
1 Sabia.						
campanulata, *Wall.* .	1	S sc	10'—15'	Pr.	March ...	Gágar, Námik,
purpurea, *H. f. and T.*,	3	Sh.	10'	...	May ...	Sarju valley, Bágesar
paniculata, *Edgew.* ..	2	S. sc.	30'—40'	...	March ...	Outer hills ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himálaya*		Tibet.	Remarks
		Rainy	Dry.		
Open ..	4—5,000	R.	...	...	
Forest .	3,000	R	.	...	
Do.	6—9,000	R	...	...	= *Pavia indica* and *Engelhardtia* No 2 in Herb S. & W
Do .	1,500	R.		...	
Do.	3,000	R.	.	...	
Do. ..	4—7,000	R		...	
Do ..	6—7,000	R			
Do	8,500	R		...	
Do. .	7—5,900	R		.	
Do. .	7, 5—11,000	R	.	..	
Do. ..	6—8,500	R	...	..	
Do. ...	7—8,000	R.	...	...	
Do. ..	6—8,000	R.	.	...	
Do ..	3,000	R	.	...	
Do. ...	1—2,000	R.	. . .	...	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth	Height of plant.	Colour of flower.	Time of flowering.	Locality.
2. Meliosma						
dilleniæfolia, *Wall.* ..	2	T	40′	Wh.	June ..	Námik, &c. .
pungens, *Wall.* .	1	T	40′	Wh	May ..	Kapkot, Binsar,
XXXV.—ANACARDIACEÆ						
1. Rhus.						
Cotinus, *L* ..	2	Sh	10′	Pk	April ..	Gágar, Almora,
parviflora, *Roxb.* ...	1	T.	20′	...	.	Almora, &c
semialata, *Murray* ...	4	T	15′	..	June ..	Almora, &c.
succedanea, *L.* ..	3	T	20′	...	March ..	Bagesar ..
2. Pistacia.						
integerrima, *Stewart*,	..	T	30′—40′	...	May ..	Thaknia, Kosi River
3. Mangifera.						
indica, *L* .	...	Tr.	40′	Y.	April ..	Bhábar, plains, Almora, &c
4 Buchanania						
latifolia, *Roxb.* ...	...	Tr.	30′	Wh	March .	Outer hills ..
5 Odina.						
Wodier, *Roxb*		Tr	30′	Wh.	March .	Bhábar . .
6 Semecarpus						
Anacardium, *L f.*	...	Tr.	30′—40′	...	January ..	Outer hills
7 Spondias.						
mangifera, *Willd.* .	...	Tr	..	..	...	Bhabar ...
XXXVI.—CORIARIEÆ.						
1 Coriaria.						
nepalensis, *Wall.* ..	..	Sh	10′—12′	...	February,	Common ..

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya*		Tibet	Remarks
		Rainy	Dry.		
Do ...	7,5—9,000	R.	...	...	
Do. ..	3,5—7,500	R	.	...	
Do ..	5—5,000	R		. .	
Do .	3—5,000	R		.	
Do. .	4—6,500	R	.	.	
Do .	3—3,500	R	.	.	
Do. ..	2—5.000	R.	. .		= *Rhus integerrima* in Herb. S. and W.
Cultivated ..	1—2,500	R.	.	.	
Forest ...	1—2,000	R	...	...	
Do. .	1,000	R.	..	...	
Do. ..	1—2,000	R	.	.	
Do. ..	1—2,000	R.	...	...	
Open ...	2—7,000	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant	Colour of flower.	Time of flowering.	Locality.
XXXVII.—MORINGIEÆ						
1. Moringa.						
pterygosperma, *Gaertn.*	...	T.	40′	Pk.	March .	Bhábar .
XXXVIII.—LEGUMINOSÆ.						
1 Piptanthus.						
nepalensis, *D. Don.* ...	...	Sh.	10′	Y	May	Káthi Pass ...
2 Thermopsis.						
barbata, *Royle.* ..	1	H	2′	Y. ?.	July .	Milam, Rálam,
inflata, *Camb* .	2	H	6″ – 9″	Y.	July .	Raj-hoti
3. Argyrolobium						
flaccidum, *Jaub & Spach*	1	Sh	1′	R.	July	Naini Tal
roseum, *Jaub & Spach*	2	Sh	1′	R	July .	Kálá pathara, &c
4 Crotalaria.						
prostrata, *Roxb* ..	9	H.	6″	Y ?	July .	Almora ..
humifusa, *Grah* ..	11	H	6″	Y	.	..
alata, *Ham*	3	H.	1′	Y	July	Almora .
mysorensis, *Roth* ...	4	H	2′	Y. ?	August	Hawalbágh
albida, *Heyne* .	7	H.	1′	Y.	April	Almora, &c. .
calycina, *Schrank* ...	5	H	6″—9″	Bl ?	August ..	Almora .
sessiliflora, *L* ..	2	H	1½′- 2′	Bl	July	Almora .
sericea, *Retz* .	6	H	3′—4′	Y	February,	Naini Tál, Bágesar
tetragona, *Roxb.*	1	H	6′	Y	September,	Sarju valley . .
medicaginea, *Lam.*	.			..	.	
var *neglecta* ...	8	H	2″	Y.	March .	Kota Dún .
juncea, *L.* ..	10	H.	2′	Y	July .	Almora .
5 Parochetus.						
communis, *Ham.* .	..	H. cr	6″	Bl	May ...	Chaur, Rálam, &c

Plants—(continued).

Conditions of soil, &c.,	Elevation in feet above the sea	*Himálaya*		Tibet.	Remarks
		Rainy	Dry		
Forest	1—2,500	R	.	...	
Do.	2,000	R.	..	.	
Open	10—12,000	R	D	..	
Do.	13—15,000	.	D.	T.	
Do	7—8,000	R.	.	.	
Do	2,5—6,500	R	.	.	
Open	3—4,500	R	..	..	
...	?	...	...	...	
Do	3—5,500	R	...	...	
Do	4,000	R	..	.	
Do	4 6,500	R	...	.	
Do.	5,500	R	...	..	
Do.	5—8,000	R	..	...	
Do	3 5,000	R	...	...	
Do	3,500	R.	...	...	
...		..	...	.	
Do	2,000	R.	..	...	
Gardens	5,500	R.	...	...	
Open	6—10,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
Trigonella.						
Fœnum-græcum, *L.* ..	7	H	..	..	...	Almora ..
gracilis, *Benth* ...	3	H.	3′	Y.	July ..	Naini Tál ..
pubescens, *Edgew.* ..	6	H	1½′	Y.	June ..	Naini Tal ...
emodi, *Benth* ..	4	H	2′	Y.	July ...	Sálu ..
corniculata, *L.* .	2	H.	6″—9″	Y.	June	Ramni, Niti .
Melilotus.						
parviflora, *Desf.* ...	1	H.	1½′	Y.	March ..	Almora, &c. ...
alba, *Lam* ..	2	H	3′	Wh	February,	Haldwáni
Medicago.						
lupulina, *L.*	1	H. or	3″	Y.	March .	Outer hills ...
denticulata, *Willd.* ..	2	H.	9″	Y.	March ...	Bhábar ..
Lotus.						
corniculatus, *L.* ..	..	H.	6″	Y.	All the year	Almora &c. ...
Indigofera.						
trifoliata, *L.* ..	2	H.	9″	Pr	August	Almora, Sarju valley.
hirsuta, *L.* ..	1	H.	12″	Pr.	July ..	Almora .
Gerardiana, *Wall.* var heterantha ..	3	Sh.	3′—5′	Pr	January	Almora, Binsar,
atropurpurea, *Ham.* .	4	Sh	8″	Pr	June .	Gangoli, &c ..
hebepetala, *Benth* ..	4½	Sh.	8′	Pr.	June .	Kathi .
pulchella, *Roxb.* ..	5	Sh.	8′—10′	Pk.	February,	Outer hills, Bágesar,
Dosua, *Ham* ..	6	Sh	2′—3′	Pk	June ...	Binsar, &c ..
Milletia.						
auriculata, *Baker* ..	..	Tree	30′—40′	..	...	Bhábar ..
Tephrosia.						
candida, *DC.* ..	1	Sh	8′—10′	.	January .	Kota Dún ..
purpurea, *Pers.* .	2	Sh	1′—2′	Pk	March ..	Do ...
Sesbanea.						
aculeata, *Pers* ...	...	H	2′	Y.	August .	Háwalbágh ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himalaya* Rainy.	*Himalaya* Dry	Tibet	Remarks.
Cultivated	5,000	R	...	...	
Open	7,000	R	...	...	
Do	7,000	R	.	...	
Woods	9,000	R	..	...	
Open	9—11,500	R	D	...	
Do	1—,500	R	..	...	
Do.	1,500	R	...	...	
Do	4,000	R	. .	...	
Do	1,000	R	...	.	
Do	4,700	R.	...	...	
Do.	4,000	R	..	...	
Do.	4—5,000	R.	...	..	
...	...		...	...	
Do.	4—7,000	R	...	.	
Do.	4—6,000	R	..	..	
Do	7,000	R	..	..	
Do	2 —6,500	R	...	.	
Woods	5—8,500	R	...	...	
Forest	1—3,500	R.	...	..	
Open	2,000	R	..	..	
Do.	2,000	R.	...	...	
Fields	4,000	R.	..	...	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
Caragana.						
pygmæa, *DC* ..	1	Sh	1′—4′	Y.	July	Gugé plains
Gerardiana, *Royle* .	2	Sh	3′	Y.	July	Dhauli river ..
polyacantha, *Royle*	4	Sh		..	...	?
crassicaulis, *Benth* ...	3	Sh	3″—4″	Or.	July ..	Pindari, Milam,
Astragalus.						
trichocarpus, *Grah* .	1	H	3′	Pk	April ..	Naini Tal ..
hosackioides, *Benth*	.	H	1′—1½′	Y. Or	March	Naini Tál ..
strictus, *Grah* .	11	H	4″—6″	Bl	September,	Shelong
melanostachys, *Benth* .	12	H	6″	.	July ..	Rajhoti
inconspicuus, *Baker*,	10	H	6″	Bl	August	Ralam valley
himálayanus, *Klotzsch* ,	13	H	6″		August .	Milam
leucocephalus, *Grah*	...	H.	2″	Bl	July ..	Milam, Niti .
chlorostachys, *Lindl* .	5	H	2′	Y	July ...	Tola (Gori R.), Dwáli
emodi, *Steud.* ..	4	H.	2′	...	July .	Gori river
graveolens, *Ham.* .	2	H	2′—3′	Y	March ..	Outer hills
Webbianus, *Grah*	7	Sh	6″—8″	Y	July	Gugé plains
polyacanthus, *Royle*	6	Sh	1½′	Y	August .	Dhauli river
multiceps, *Wall*	8	Sh	3″—4″	Y	August .	Milam ..
Oxytropis.						
lapponica, *Gaud*	7	H	4″ 6″	Pr	July	Rajhoti
Stracheyana, *Benth*	5	H	2″	Bl	August ..	Gugé plains
tatarica, *Jacquem.*	3, 4	H	2″—1″	Pr	July - August	Rajhoti, Gugé plains
microphylla, *DC*	2	H.	3″	...	July	Gugé plains
Lezpedeza.						
sericea, *Miq.* .	1	Sh	1′—8′	Pk.	February,	Rámganga river
Gerardiana, *Grah* ...	2	Sh	1½′	Pk.	August	Almora, &c.
eriocarpa, *DC* ..	3	Sh	4′—5′	Pk.	February,	Gágar, Kalimat,
Hedysarum.						
Kumaonense, *Benth* .	...	Sh.	9″	...	August .	Gori river ...
Stracheya						
tibetica, *Benth* ...	..	H	1″—2″	...	July ..	Tisum ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himálaya*		Tibet	Remarks.
		Rainy	Dry		
Open .	14—17,000	.	D	T.	
Do .	9—12,000		D	.	
	?	.	D?	.	
Do	12—15,000	R	D	T	
Do	7,000	R.	.	...	
Do ...	6—7,000	R	.		=*Podolotus hosackioides* in Herb S and W
Do ..	13—15,500	.	D	T	
Do .	15,000		.	T	
Do. ...	9,000	R	.		
Do.	12,400	.	D		
Do. .	11—15,000		D	T.	=*Guldenstaedtia uniflora* in Herb. S and W.
Do ..	8—11,500	R	D.		
Do. .	10,000	R.	.		
Do ..	2,000	R	..	.	
Do .	15,000	.	...	T	
Do. ..	7,000	R		..	
Do ..	11,500	..	D	..	
Do	15,000	...	...		
Do. ..	15,500	..	..	T.	
Do ..	15,500	..	..	T	
Do. ...	15,500	..	.	T	
Do .	4,500	R	.	..	
Do. ..	5—6,500	R	.	...	
Do. ..	6,000	R.	...	...	
Rocks ..	9,000	R.	...	...	
Open ...	15,000	..	...	T.	

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth	Height of plant.	Colour of flower.	Time of flowering.	Locality.
Zornia.						
diphylla, *Pers* ...	1, 2	H.	4″–6″	...	June ...	Almora ..
Smithia.						
ciliata, *Royle* .	.	H	6″	Y.	July ..	Almora ..
Æschynomene.						
indica, *L.* ...	..	H	4′	Y	July .	Almora ..
Uraria.						
picta, *Desv* .	1	H	1′–6′	Y	July ...	Bageswar .
lagopus, *DC*	2	H	1′–3′	Y.	August .	Almora, Paton,
Alysicarpus.						
vaginalis, *DC* ...	2	H	9″ 12″	..	July ..	Almora .
bupleurifolius, *DC*,	1	H.	1′	..	July	Háwalbágh ..
rugosus, *DC* .	3	H	9″	..	July .	Do. .
Ougeinia.						
dalbergioides, *Benth*,	.	T	30′	Pk.	October ...	Outer hills .
Desmodium.						
laburnifolium, *DC*,	...	Sh.	3′	...	August	Bágesar valley,
triquetrum, *DC.* ..	...	Sh	2′	.	August	Baiznáth ..
laxiflorum, *DC* .	5	Sh	4′	Pk.	August ..	Sarju river .
podocarpum, *DC.* ..	8	Sh	3′	Pk	August .	Naini Tál below
floribundum, *D. Don*,	2	Sh	2′—3′	Pk W	July	Naini Tál ...
oxyphyllum, *DC.* ..	9	Sh	3′–6′	La	July ..	Naini Tál below
tiliæfolium, *G. Don*,	6	Sh.	6′–10′	Pk.	August .	Gori river ..
gangeticum, *DC* .	1	Sh.	3′—4′		March ..	Káladhúngi, Bhábar.
sequax, *Wall* ...	7	Sh.	3′	Pk.	August ..	Naini Tál below.
concinnum, *DC* ...	10	Sh	2′	La.	August ...	Binsar ...
polycarpum, *DC* .	.	..		.	...	...
var trichocaulon .	14	S cr	1′	Pr	August .	Almora, Naini Tál

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himálaya*		Tibet	Remarks.
		Rainy.	Dry		
Open	4,000	R	.	.	
Wet	4,000	R	.	...	
Do.	4,000	R.	.		
Open	3,000	R	...		
Do.	4–5,000	R	..		
Do.	4,000	R.	.	.	
Do.	4,000	R	.	..	
Do.	4,000	R.	...	..	
Do.	1–4,000	R	..	...	
Woods	3,000	R.	...	...	=*Catenaria laburnifolia* in Herb, S and W.
Open	4,500	R	...	...	=*Pterolama triquetrum* in Herb S and W.
Forest	3–6,000	R	.	...	
Woods	6,500	R.	.		
Forest	4–7,000	R		...	
Woods	6–8,000	R.	...	..	
Forest	5–6,000	R		..	
Do.	1–2,500	R	...	..	
Do.	4,000	R.	...	..	
Woods	4–6,000	R.	.	..	
...	...	...	..	...	
Open	4–7,000	R.	..	..	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
triflorum, *DC* ..	13	H	1′	Pk.	August ...	Almora ...
heterophyllum, *DC.*,	13½	H.	1′	Pk.	...	Do ..
parvifolium, *DC.* ..	4	S. cr,	1′	Pk	August ..	Almora, Naini Tál.
gyrans, *DC.* ...	11	Sh.	3′	Pr	*August* ...	Almora ...
Abrus.						
precatorius, *L.* ..	1	S. sc.	4′—8′	...	February,	Bhábar .
pulchellus, *Wall.* ..	2	S. sc.	8′—10′	...	February,	Kota dún, &c.,
Cicer.						
arietinum, *L.* .	2	H.	1′	Bl.	March ..	Bhábar ..
soongaricum, *Steph*...	1	H	1′—2′	Bl.	July ..	Milam, Laptel,
Vicia.						
tetrasperma, *Mœnch.*,	..	H. cr	1′—2′	Bl.	March ..	Almora ...
hirsuta, *Koch.* ..	.	H cr	1′—2′	Bl.	March ...	Do ...
tenera, *Grah* ..	3	H	1′	Pr.	April ..	Ramgar, Naini Tál.
rigidula, *Royle* ..	2	H	10′—15′	Pk W	August ...	Jalat, &c ...
sativa, *L.* .	4	H.	1′	Pr	July ..	Naini Tál ...
var. angustifolia ...	1	H	6″	Pk.	March ...	Almora ..
Lathyrus.						
Aphaca, *L.* ..	1	H.	1′	Y	March .	Almora ...
sativus, *L* ..	3	H.	2′	R. Pr.	March ...	Sirmora ...
sphæricus, *Retz.* ..	2	H.	6″—9″	R	March ..	Almora ...
luteus, *Baker* ..	...	H.	4′	Y	May ..	Mádhári Pass. .
Pisum.						
sativum, *L.* ...	.	H.	2′	Wh.	March ...	Common ...
Shuteria.						
vestita, *W. & A* ..	...	...	...	...	...	...
var involucrata, ...	2	S cr.	...	...	...	Naini Tál, &c...
„ densiflora ...	1	S cr.	10′—15′	...	February,	Outer hills ..
Dumasia.						
villosa, *DC.* ...	...	S cr.	4′	Pr.	August ...	Almora, &c ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	4,000	R.	...	...	
Do ...	4,000	R	..	...	Not found in Herb.
Forest ..	5—7,000	R	...	...	
Open ...	1—6,000	R.	...	...	
Forest .	1—2,000	R	..	...	
Do. ...	3—4,000	R.	...	...	
Cultivated ...	1—2,000	R.	...	...	
Open ...	11,500—14,500	...	D.	T	
Fields ...	1,5—5,500	R.	..	...	= *Ervum* No 2 in Herb S. & W.
Do ...	1,5—5,500	R	..	...	= *Ervum* No. 1 in Herb. S. & W.
Woods ...	5—7,000	R	...	...	
Open & Woods	5—7,000	R	...	...	
Woods ...	7,000	R.	..	...	
Fields ...	1,5—5,500	R.	...	...	
Do ...	1,5—5,500	R.	...	...	
Do. ...	4,000	R.	...	...	
Do ...	1,5—5,500	R	...	...	
Woods ...	8—9,000	R	...	...	= *Orobus luteus* in Herb. S. & W.
Cultivated ...	1—5,000	R	...	...	
...	...		...	...	
Woods ...	3—6,000	R	...	..	
Do. ...	2,500	R	...	..	
Open ...	3,500	R	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
Glycine.						
Soja, *Sieb and Zucc.*,	...	H.	...	...	August ...	Almora, &c. ..
Mucuna						
atropurpurea, *DC* .	2	S sc	20′—30′	Pr	August ...	Kota Dún, &c.,
pruriens, *DC* ..	1	S sc	10′—15′	Pr	August ...	Kota Dún, &c.,
Erythrina.						
stricta, *Roxb.* ..	3	Tr	...	..	...	Outer hills ...
suberosa, *Roxb.* ..	2	Tr	30′	Sc.	June ...	Outer hills ..
arborescens, *Roxb.* ..	1	Sh.	8′	Sc.	August ...	Almora, Jalat,
Galactia.						
tenuiflora, *W and A*,	...	S. sc	...	...	August ...	Gangoli ..
Spatholobus.						
Roxburghii, *Benth* ..	...	H sc	50′	...	...	Bhábar ...
Butea.						
frondosa, *Roxb.* ..	1	Tr	25′	Sc	March ...	Do. ...
Pueraria.						
tuberosa, *DC* ..	...	S sc	10′—20′	Bl.	March ..	Outer hills ...
Stracheyi, *Baker* ..	...	H. sc.	5′—6′	R.	August ...	Kalimundi ...
Phaseolus.						
calcaratus, *Roxb.* ..	...	H sc.	...	Y.	August ...	Almora ...
Vigna.						
vexillata, *Benth* ...	...	H sc.	2′	Pk	August ...	Jágesar ...
Dolichos.						
Lablab, *L.* ..	...	H.	..	...	...	Almora ..
biflorus *L* ..	1	H sc	1′–1½′	...	August ..	Almora ...
falcatus, *Klein* ...	2	H sc.	5′	Pk.	August ...	Gangoli, Naini Tál

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himálaya*		Tibet.	Remarks.
		Rainy.	Dry.		
Cultivated .	1—5,500	R.	.	...	
Open ..	3—6,000	R.	.	..	Not found in Herb S & W.
Do. ...	2,5—4,000	R	...	. .	Not found in Herb S & W
Forest .	1—5,000	R	.	.	Not found in Herb S. & W.
Do .	2,500	R.	...	.	
Open .	4—6,200	R.	...		
Do ...	4,000	R	. .		
Forest ...	1,000	R.	...	.	= *Butea parviflora* in list. Not found in Herb S. & W.
Do. ...	1,000	R	..	. .	Not found in Herb S. & W.
Woods ..	2—4,000	R	...	...	
Woods ..	6—7,500	R.		...	= *Neustanthus* sp in Herb. S. & W.
Open ...	4—5,000	R	.	.	
Do. ...	5—7,000	R	...	.	
Cultivated ..	1—5,000	R	...	..	= *Lablab vulgaris* in list, Not found in Herb. S. and W.
Do. ...	1—6,000	R	..	. .	
Open . .	5—7,500	R.	...	. .	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower	Time of flowering.	Locality.
Atylosia						
mollis, *Benth.* ...	2	S sc	15′–20′	Y.	March .	Sarju valley, Bhábar.
grandiflora, *Benth* ...	1	S sc.	6′–12′	Y.	September,	Bágesar ..
scarabæoides, *Benth.*,	3	H	1′	Y.	August ...	Almora ...
Cajanus.						
indicus, *Spreng* ..	.	H.	2′	Y.	October ...	Ganai ...
Eriosema.						
chinense, *Vogel*	..	H.	1′	Y.	August ..	Almora ..
Rhynchosia.						
pseudo-cajan, *Camb*	1	Sh	8′	Y	August .	Kosi and Sarju valleys
himálensis, *Benth.* .	3	H. sc	10′	Y Pr.	August .	Gágar, &c. ...
sericea, *Spanoghe* .	2	H. cr	6′	Pr.	August .	Kilimundi river
vestita, *Benth* ..	4	H. sc.	3′ - 4′	R.	August .	Naini Tál, Binsar, &c.
Flemingia						
strobilifora, *R. Br*	4	Sh	1′	Pk.	August .	Almora, Binsar,
paniculata, *Wall* .	3	Sh	1′	..	August .	Outer hills ...
congesta, *Roxb* ..	5	Sh	2′–3′	Pk	August .	Bhábar ..
var semialata .	1, 2	Sh	1′– 3′	. .	July ..	Bágesar, Almora, &c
Dalbergia						
Sissoo, *Roxb*	1	Tr	25′	Pk.	February,	Bhábar ..
confertiflora, *Benth* ..	2	S sc	15′	Li.	March .	Do .
volubilis, *Roxb* .	3	Tr	20′–30′	Pk.	May .	Kosi valley, .
Sophora.						
mollis, *Grah.*	...	Sh	6′–8′	Y.	February,	Common ..
Cæsalpinia.						
Bonducella, *Fleming*,	...	S sc	10′–15′	Y	March ...	Kota, &c. ...
sepiaria, *Roxb.* .	...	S. sc.	10′–15′	Y.	March ...	Do. ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya*		Tibet.	Remarks.
		Rainy.	Dry.		
Woods	1—4,000	R.	...	...	
Do	3,000	R	...	...	
Open	4—5,000	R	...	...	
Cultivated	3,000	R	...	...	Not found in Herb S & W.
Open	5—6,000	R	...	...	
Do.	3—4,000	R.	...	...	
Do.	6—7,000	R	...	...	
Do.	2—5,500	R	...	...	
Do.	6—7,500	R	...	...	Not found in Herb. S & W.
Do.	3, 5—8,000	R.	...	...	
Forest	2,500	R	...	...	
Do	1—2,000	R	...	...	
Woods & open,	3—6,000	R.	...	...	
Forest	1—2,000	R	...	...	
Do.	1—2,000	R.	...	...	Not found in Herb. S. & W.
Do.	3—4,000	R	...	...	
Open	3,5—5,000	R	...	...	=*Edwardsia mollis* in Herb. S & W.
Do.	2—3,000	R.	...	...	=*Guilandina Bonducella* in Herb. S. & W.
Do.	2—5,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality
Cassia						
Fistula, *L.* .	1	Tr,	25′	Y.	April ..	Outer hills ..
occidentalis, *L* ..	2	H.	2′—3′	Y.	March ..	Bágesar, &c ...
Sophera, *L.* ..	3	H	3′- 4′	Y	March . .	Outer hills
Tora, *L.* ..	4	H.	3′	Y.	All the year	Bágesar, &c ...
Absus, *L* ..	5	H	1′	Y.	August	Almora, &c . .
mimosoides, *L.* ..	...				...	...
var, Wallichiana .	7	H.	1′- 1½′	Y.	August ...	Do. ..
Saraca.						
indica, *L.* ...	...	Tr.	25′	R Or.	March ..	Kota Dún ..
Tamarindus.						
indica, *L* ..	...	Tr	60′—80′	...	...	Bhábar ..
Bauhinia						
malabarica, *Roxb*	...	Tr	25′	...	...	Bhábar ...
retusa, *Ham* .	...	Tr	20′ 40′	Pk.	September,	Kosi valley ..
Vahlii, *W & A*	..	S. sc.	20′ - 40′	Pk	January ...	Bhábar, outer hills
variegata, *L.* ..	...	Tr	25′—30′	Pk. W.	March ...	Outer hills ...
Mimosa						
pudica, *L* ..	1	Sh.	2′	Pk	April ...	Kota Dun .
rubricaulis, *Lam.* ..	2	Sh.	6′—10′	R.	June ...	Ramgarh valley, &c.
Acacia.						
Farnesiana, *Willd.* ..	2	Sh.	10′	Y.	June ...	Almora ..
eburnea, *Willd* ..	3	Tr	15′	Wh	January .	Bhábar ..
Catechu, *Willd*	1	Tr.	20′—30′	..	January ..	Bhábar ...
Intsia, *Willd.*	4, 5	Tr or S sc.	20′—30′	Y.	July ...	Bhábar, Bágesar
Albizzia.						
Lebbek, *Benth.* ...	3, 4	Tr.	20′—30′	Y.	May ...	Bágesar, Bhábar.
Julibrissin, *Durazz* ...	...	..	...	..	...	...
var mollis ...	2	Tr	25′	W.	May ...	Naini Tal, &c ,
stipulata, *Boiv.* ..	1	Tr.	30′—40′	Y.	May ..	Outer hills, Daisani.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himalaya.* Rainy	*Himalaya.* Dry	Tibet	Remarks.
Forest .	1—3,000	R.	.	...	
Shade	1—4,000	R	.	.	
Do .	1—2,500	R.	.		Not found in Herb. S & W.
Open	1—4,000	R	..	..	
Do. ..	1—4,000	R		.	
Do.	4—5,000	R.	..		
Cultivated ..	2,000	R	...	...	=*Jonesia Asoca* in Herb. S & W.
Forest ..	1,000	R.	.	.	
Do ..	1,000	R	...	.	=*Piliostigma malabaricum* in Herb. S & W.
Woods	1—3,500	R.	..	..	=*Phanera retusa* in Herb. S. & W.
Forest ...	1—3,000	R		...	=*Phanera Vahlii* in Herb. S. & W. The flowers of this species are usually yellowish white. J. F. D.
Woods ...	3—4,000	R	.	...	=*Phanera variegata* in Herb. S. & W.
Cultivated ..	2,000	R.	..	.	Not found in Herb. S & W.
Open ...	1—6,000	R	...	.	
Gardens ...	6,500	R.	.	...	Not found in Herb. S
Forest ...	1—2,000	R	...	...	
Do. ..	1—2,500	R	.	.	Not found in Herb. S & W.
Do. ..	1—3,000	R.	.	.	
Do ..	1—3,000	R.	..	...	No. 3 not found in Herb. S & W.
	...		..	.	
Do. ...	5—7,000	R.	...	...	Not found in Herb. S & W.
Do. ...	2—7,000	R.	...	...	

List of Kumaon

Name.	*Herbarium* number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower	Time of flowering.	Locality.
ROSACEÆ.						
Prunus						
persica, *Benth & Hook.*	...	Sh.	...	...	March ..	Almora ...
armeniaca, *L.* .	...	Sh.	...	...	March	Do. ...
Jacquemontii, *Hook f.*	..	Sh.	5′	..	June .	Niti ...
Puddum, *Roxb* ..	..	Tr	20′	Pk	November,	Almora, &c. .
Padus, *L* .	...	Tr.	30′—50′	Wh.	April .	Naini Tál, Dwáli, &c
nepalensis, *Ser*	...	Sh.	10′—15′	Wh	April ,	Chaur ..
undulata, *Ham.*	...	Tr.	20′—30′	..	April ...	Naini Tál, Binsar
Prinsepia.						
utilis, *Royle* ...	...	Sh.	6′	Wh.	January ...	Almora, &c ..
Spiræa.						
vestita, *Wall.* ...	5	H.	2′—3′	Wh	August ..	Rálam, &c. ...
sorbifolia, *L* ..	4	Sh.	10′—10′	Wh.	June ...	Dwáli, Niti ...
bella, *Sims* .	1	Sh	6′	Pk.	May ..	Káthi Pass, Chechanietchal.
canescens, *Don* ...	2	Sh.	10′—15′	Wh.	May ...	Common ...
vacciniifolia, *Don.* ..	3	Sh	6′	Wh.	June ...	Almora, &c. ...
Rubus.						
paniculatus, *Sm.* ..	9	Sh	10′	Wh	May ..	Tola (Sarju valley)
reticulatus, *Wall.* ..	8	Sh	10′	Wh.	June ..	Láhúr, Dwáli .
lanatus, *Wall.* ...	10	Sh.	15′	Wh.	April .	Gagar, Binsar,
alpestris, *Bl.* ...	17	Sh	.	..	..	Tungnáth ..
saxatilis, *L.* ..	5	Sh	1′	...	July ..	Martoli ..
nutans, *Wall.* ..	6	S. cr	1′—3′	Wh	May .	Láhúr
niveus, *Wall.* .	4, 7	Sh	10′—12′	Pk.	June .	Namik, Rámri, Rún Pass.
macilentus, *Camb.* ..	1	Sh	10′	Wh	May .	Binsar, Mádhári Pass
ellipticus, *Sm.* ..	11, 12	Sh	6′—8′	Wh	April-May,	Outer hills, Binsar, &c
biflorus, *Ham* ..	13, 15	Sh.	6′—8′	Wh	April .	Naini Tál, Binsar, &c
lasiocarpus, *Sm* ...	3, 14	S. cr	6′—12′	R Pk.	May-February	Kota Dún, Naini Tál, Binsar, &c.
var. membranaceus ...	13	Sh.	6′	Wh	June ..	Chiring Pass ..

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	Himálaya. Rainy.	Himálaya. Dry.	Tibet	Remarks.
Cultivated ..	1—5,000	R	...	...	= *Persica vulgaris* in list Not found in Herb. S. & W
Do. ...	5,000	R.	...	...	= *Armeniaca vulgaris* in list. Not found in Herb S & W.
Open ...	11,500	.	D	...	= *Cerasus* No 5 in Herb. S & W.
Do. ...	2, 5—6,000	R	...	...	= *Cerasus* No. 4 in Herb S. & W.
Forest ..	7,500—11,000	R.	...	...	= *Cerasus* No 1 in Herb S & W.
Open ...	6,000	R.	...	...	= *Cerasus* No. 3 in Herb. S & W.
Forest ...	7—7,500	R.	...	...	= *Rhamnus* No 5 in Herb. S & W.
Open ...	3—8,000	R.	D.	...	
Do, ...	9—12,000	R	D.	...	
By streams ...	7—12,000	R	D.	...	
Forest ...	9—10,000	R	...	...	Not found in Herb. S. & W.
Open ...	5—7,500	R	..	...	
Do. ...	7, 5—6,000	R	...	...	
Do. ...	6,500	R.	...	...	
Woods ..	7—8,000	R	...	...	
Open ..	6—8,000	R.	...	...	
Woods ...	7,500	R.	..	...	
Open ...	11,000	..	D	...	
Open ...	7, 500—10,000	R	..	...	
Forest & open,	8—10,700	R	...	...	
Woods ...	7—8,000	R.	...	...	
Woods & open,	4—7,500	R.	...	...	
Woods ...	7—7,500	R.	...	..	
Do. ...	1, 5—7,000	R.	...	...	
Woods ...	7,500	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant	Colour of flower.	Time of flowering.	Locality.
rosæfolius, *Sm.* ..	2	Sh	10′	Wh	May ..	Naini Tal ..
parvifolius, *L.* ...	15	Sh.	8′	Pk.	April ..	Naini Tál, Binsar.
Geum.						
urbanum, *L.* ...	...	H.	2′-3′	Y.	June ..	Námik, &c. ..
elatum, *Wall.* ..	...	H.	9″	Y	June ..	Pathar, Kori ...
Fragaria						
indica, *Andr* ...	3	H.	3″—4″	Y	April ...	Outer hills
vesca, *L* ..	1	H	2″-3″	Wh	May ..	Pindari Rogila,
var. nubicola ..	2	H	3″ 4″	Wh	May ..	Naini Tál, Dwali
Potentilla.						
purpurea, *Royle* ..	...	H	2″	Pr	August ..	Barjikang, &c,
albifolia, *Wall* ..	..	H.	4″—12″	Y	May ..	Námik, Rálam,
procumbens, *L.* ..	...	H	3″—9″	Y.	July ..	Mádhari Pass, Rálam, &c
fruticosa, *L.* ..	1, 2, 2½, & 3.	Sh.	4″—3½′	Y	August ...	Milam, Niti, Pitti and Gori rivers, Pindari, &c
ambigua, *Camb* ..	5	H.	4″	Y.	August ..	Rálam, Milam,
eriocarpa, *Wall* ..	4	Sh	1′	Y.	August	Pindari, Singjari
Mooniana, *Wight* ...	14	H.	1′—3½′	Y.	August ..	Kálimundi, Rálam
fulgens, *Wall.* ..	13	H	1′	Y.	July ..	Naini Tál, Binsar, &c
Leschenaultiana, *Ser*,	9, 20	H.	9″—2′	Y	March-August.	Naini Tál ..
var. bannehalensis,	15, 16	H.	2′—3′	Wh	August ...	Jalat, Tola (Gori valley),
peduncularis, *Don.* ..	...	...	...	...	...	...
var obscura, ..	17	H.	1′	Y.	July ..	Rálam .
leuconota, *Don.* ..	29	H.	1′	Y.	June ...	Rálam, Dudatoli
microphylla, *Don* ..	19	H.	1″—2″	Y.	July ..	Barjikang, &c.
var commutata ...	18	H.	3″—4″	Y	July ...	Do ...
bifurca, *D* ..	27	H	2″—3″	Y	July ...	Milam, Gugé,
multifida, *L.* ..	22, 23	H.	3″—12″	Y.	July ...	Níti pass, Hoti, &c.
var Saundersoniana,	23 (in part).	H.	...	Y.	July ...	Do. ...
sericea, *L* ...	21	H.	3″—9″	Y	July ..	Malari, Gugé .
nepalensis, *Hook* ...	10	H	1′	R.	April ...	Naini Tál, Binsar, &c.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himá-laya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Woods	7,000	R	...	...	
Do.	7,500	R	...	...	
Do.	7—11,000	R.	...	...	
Open	10—11,500	R	...	...	= *Sieversia elata* in Herb, S & W.
Do.	3—7,500	R	...	...	
Do.	11—12,500	R	...	...	
Open or woods,	8—10,500	R.	...	...	
Open	11—14,500	R.	D.	...	= *Sibbaldia* No. 4 in Herb S & W.
Do	8, 5—12,000	R.	...	...	= *Sibbaldia* No 1 in Herb. S & W.
Do.	9, 5—14,000	R.	D.	...	= *Sibbaldia* No 3 in Herb. S. & W.
Open, rocky places.	8—16,300	R.	D.	T.	
Open	11—15,000	R.	D.	T.	
Open rocks	9—12,000	R.	...	...	
Open	9—11,500	R.	...	...	
Do.	6—10,000	R.	...	...	
Do.	6—7,000	R.	...	...	
Do.	6—11,500	R.	D.	...	
...	...	...	...	...	
Do.	13,000	R	...	...	
Do.	10—12,000	R	...	...	= *Sibbaldia* No. 2 in Herb. S. & W.
Do.	10—14,500	R.	...	...	
Do.	10—14,500	R.	...	...	
Do.	12—16,000	...	D.	T.	
Do.	15—17,000	...	...	T.	
Do	Ditto	...	...	T.	
Do.	10—15,500	..	D.	T.	
Do	7—8,500	R.	...	...	

Name	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower.	Time of flowering.	Locality.
argyrophylla, *Wall.* ..	7	H	2'—3'	Or.	August ..	Sába, Rálam ...
var atrosanguinea,	8	H	2'—3'	R. Or	August .	Barjikáng, Pindari, &c
" leucochroa ...	6	H.	9"—13"	Y.	August ...	Barjikáng, &c.
monanthes, *Lindl.* ...	12, 25	H.	1¼"—3"	Y.	August ...	Rálam, Barjikang.
var. —— ...	26	H.	1"—2"	Y.	May ...	Champwa ...
Kleiniana, *W. & A.* ...	11	H.	1'	Y.	March ...	Naini-Tál, Binsar, Almora.
supina, *L.* ...	28	H.	3"—4"	Y.	January ...	Hardwár, Binsar.
8. Chamœrhodos.						
sabulosa, *Bunge.* ...	...	H	2"	Wh.	September,	Gugé ...
9. Agrimonia.						
Eupatorium, *L* ...	...	H.	2"—3"	Y.	June ...	Naini-Tál ...
10 Rosa						
macrophylla, *Lindl.* ...	2, 3, & 7	Sh	6'—10'	R.	June-July,	Ralam, Binsar, Tola, Chechanu-Khál, &c.
Webbiana, *Wall* ...	6	Sh.	6'	R	July ...	Níti ..
sericea, *Lindl* ...	4, 5	Sh.	6'—8'	W Y.	May-July,	Káthi, Milam, Níti, &c.
moschata, *Mill* ...	1	S. sc.	10'—30'	Wh.	April ...	Naini-Tál, Almora.
11. Cydonia						
vulgaris, *Pers* ...	...	Tr.	20'	...	March ..	Almora ...
12. Pyrus.						
baccata, *L.* ...	7	Tr.	20'	Wh.	April ...	Naini-Tál, Níti,
kumaoni, *Dene.* ...	6	Tr.	25'	Wh	March ...	Outer hills ..
lanata, *Don.* ...	8	Tr	40'	Wh.	May ...	Mádhári Pass, &c.
vestita, *Wall.* ...	2	Tr.	40'	Wh.	May ...	Ditto ...
Aucuparia, *Gærtn.* ...	5	Tr.	20'	Wh.	June ...	Milam ...
foliolosa, *Wall.* ...	4	Tr.	25'	Wh.	May ...	Dwáli ...
13. Stransvæsia.						
glaucescens, *Lindl.* ...	...	Tr	30'	Wh	May ...	Outer hill ...
14 Cratægus.						
crenulata, *Roxb.* ...	...	Sh	12'	Wh	April ...	Ditto.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet	Remarks.
		Rany	Dry.		
Open ...	9—11,000	R.	..	...	
Do. ...	11—14,00	R.	D.	...	
Do. ..	12—15,000	R.	D.	...	
Do. ..	12—14,500	R.	...	...	
Rocks ...	12,000	R.	.	...	
Open ...	5—7,000	R	...	..	
Do. ...	1—7,000	R.	...	...	
Do. ..	15,000	...	...	T	
Woods ...	7,500	R.	...	...	
Open woods ...	7—12,000	R.	D	...	
Do. ...	9—11,500	.	D.	..	
Do. ...	8—13,000	R.	D.	...	
Open ..	2, 5—8,500	R.	..	...	
Cultivated ..	5,000	R.	...	...	Not found in Herb. S. & W.
Open woods ...	6—11,500	R.	D.	...	
Open ...	2, 5—8,000	R.	...	...	
Forest ...	9—10,000	R.	...	...	
Do ...	8—10,000	R.	...	...	
Open ...	12,000	..	D.	...	
Forest ...	9—12,000	R.	...	...	
Woods ...	3—7,000	R.	...	...	=Pyrus No. 1, in Herb. S. & W.
Open woods ...	2,5—7,000	R.	...	...	

List of Kumaon

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth	Height of plant.	Colour of flower	Time of flowering.	Locality.
15. Cotoneaster.						
bacillaris, *Wall* ...	1	Sh.	15′	Wh.	May ..	Naini Tál, Binsar.
acuminata, *Lindl.* ...	2, 3	Sh	15′	Pk	May ...	Káthi ...
multiflora, *Bunge* ...	6	Sh.	5′	Pk.	July ...	Níti ...
microphylla, *Wall.* .	4	Sh	2′	Wh	April ...	Naini Tál, Milam.
var. —— ..	5	Sh	1′	Wh	May ..	Pindari ...
XL.—SAXIFRAGACEÆ						
1. Astilbe.						
rivularis, *Ham.* ..	...	H.	5′	Wh.	July ..	Naini Tál ...
2 Saxifraga						
sibirica, *L.* ..	5	H	6″	Wh.	August ..	Rálam ...
cernua, *L.*	6	H	4″	Wh	August ..	Barjikáng ...
palpebrata, *Hf & T.*	18	H	2″	Y.	August .	Ralam ...
Lychnitis *Hf & T*	14	H.	1″	Y	August	Barjikáng ...
saginoides, *Hf & T.*	15	H.	1″—2″	Or.	August ..	Rálam ...
Hirculus, *L.* ..	...	...	...	..	.	..
var hirculoides ..	17	H	2″—3″	Y	August ...	Barjikáng and Balch Passes.
diversifolia, *Wall.* ..	2½, 3, 4	H.	12″—15″	Y.	August ...	Barjikáng Pass, Kalmundi.
pallida, *Wall* ...	16	H.	3″	Pk.	August ...	Barjikáng ...
microphylla, *Royle* ..	24	H	...	Gr.	August .	Chorhoti Pass, Barjikáng Pass
Jacquemontiana, *Dcne.*	13	H.	½″—1″	Y	July ...	Rálam, Chorhoti Pass
var Stella-aurea ..	12	H.	½″	Y.	July ..	Barjikáng, Chorhoti Pass.
ramulosa, *Wall* ..	8, 9, 10	H.	1″—6″	Pk. Gr Y. Wh.	May, June,	Namik, Rogila, Pindari, Rákastál.
fimbriata, *Wall* ..	19	H.	4″—6″	Y.	August ...	Rálam ...
filicaulis, *Wall* ..	7	H	4″	Y.	August ...	Badárinath ...
Brunoniana, *Wall* ..	20	H.	3″—1″	Y	August ...	Naini Tál, Saba,
flagellaris, *Willd.* ...	21, 22, 23	H.	¾″—4″	Y.	August ..	Barjikáng, Lanjar, Milam.
ligulata, *Wall.* ...	...	...	...	...	...	...
var. ciliata. ...	1	H.	6″	Pk.	February,	Bagesar, Almora, &c. ...
Stracheyi, *Hf. & T*	2	H	6″	Pk.	June ...	Milam ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	Himálaya. Rainy.	Himálaya. Dry.	Tibet.	Remarks.
Woods ...	6,5—9,000	R	...	...	
Woods ...	7,5—9,000	R.	...	...	No. 2 not found in Herb. S. & W.
Open ...	11,500	..	D.	...	
Do. ...	7—11,500	R.	D.	...	
Do. ...	12,500	R.	...	...	
Woods ...	6—7,000	R.	...	...	
Open ...	11,5—14,500	R.	...	...	
Do. ...	14,500	R.	...	...	
Do ...	12,000	R.	...	...	
Do. ...	14,500	R	...	...	
Do. ...	13,000	R.	...	...	
Do. ...	13—17,000	R.	D.	T.	
Do. ...	7—13,000	R.	...	...	
Do. ...	14,500	R.	...	...	
Do. ...	14,500	R.	...	...	
Do. ...	13—16,000	R.	D.	T.	
Do. ...	11—16,000	R.	D.	T.	
Shady rocks & open.	8,5—15,500	R.	D	T.	
Open ...	11,500	R.	...	...	
Do ...	10,000	R.	D.	...	
Shady rocks ...	7—9,000	R	...	...	
Open ...	13—17,000	R.	D.	T.	
...	...	R.	...	...	
Shady rocks ...	3—10,000	R.	...	...	
Open ...	11—12,000	...	D.	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant	Colour of flower.	Time of flowering.	Locality.
3. Chrysosplenium						
trichospermum, *Edgw*	2	H.	6″	Gr.	May ...	Dwáli, Mádhári Pass
tenellum, *Hf. & T*	1	H.	½″ 1″	Gr	May ...	Mádhári Pass,
4. Parnassia.						
nubicola, *Wall.* ..	1	H	8″ 12″	Wh.	July ..	Naini Tál, &c.
ovata, *Ledeb* .	3	H	2″ 3″	Wh	August .	Rajhoti, Tisum,
pusilla, *Wall.* .	2	H.	2″	Wh	August ..	Barjikáng Pass.
5. Hydrangea.						
altissima, *Wall.* ...	1	S sc	30—40	Gr W	May ...	Darki-binaik, &c
aspera, *Don.*	3	Tr	20′	...	..	Tola (Sarju valley)
vestita, *Wall.* .	2	Tr	10′—20′	Gr. W	July ...	Rámni, Dwáli
6. Deutzia.						
corymbosa, *Br.* ..	1	Sh	15′	Y. Wh	May ...	Namik, Binsar, &c
staminea, *Br.* ..	2	Sh	10′	Y Wh	May ..	Common ...
macranthus, *Hf. & T.*	3	Sh.	10′	Y Wh	May	Binsar ..
7. Philadelphus.						
coronarius, *L* ..	...	Sh.	12′	Wh.	May ..	Káthi, &c ...
8. Itea.						
nutans, *Royle* ..	...	T.	15′	Wh.	May ...	Bágesar, outer hills
9. Ribes.						
Grossularia, *L.* ...	1	Sh.	8′	Gr.	June ...	Tola, Milam ...
orientale, *Poir* ..	2	Sh.	6′	...	June ...	Malári, Níti ..
glaciale, *Wall.* ..	3, 5	Sh.	6′—15′	...	May ...	Milam Pindari, Láhú, Dwáli
rubrum, *L.* .	1	Sh.	15′	.	May ...	Dwáli, Rámni,
XLI.—CRASSULACEÆ.						
1. Tillæa						
pentandra, *Royle* ..	..	H	2″—3″	Gr Y	July ...	Naini Tál, Almora

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry		
Wet banks ...	7—8,000	R	...	...	
Do. ...	10,000	R	...	...	
Open wet ..	7,5—9,000	R	...	...	
Do. ..	15,000	..	...	T.	
Do ...	14,500	R	...	...	
Forest ...	7,500	R.	...	...	
Do ...	6,500	R.	..	...	
Do. ...	8—11,000	R.	...	...	
Do. ...	7—8,000	R.	...	...	
Do. ...	5—7,500	R.	...	...	
Do. ...	5,500	R.	...	. .	
Do. ...	7—8,000	R.	...	...	
Do. ...	3—4,000	R	...	...	
Open ...	11,500	...	D.	...	
Do. . .	10 -11,500	...	D.	...	
Open and on trees.	7—12,000	R.	D.	...	
Open woods ..	8—10,000	R.	...	...	
Wet banks ...	5—8,000	R.	...	...	

List of Kumaon

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth	Height of plant	Colour of flower.	Time of flowering.	Locality
2. Crassula.						
indica, *Dcne* ...	1	II.	8″	Gr. W	July ...	Gagar, Patoi,
3. Kalanchœ.						
spathulata, *DC* ...	..	II.	2′—3	Y.	August	Almora, &c. ...
4. Cotyledon.						
Oreades, *C. B. Clarke*,	...	II.	1″—2″	Y	July ...	Rálam, Shelong
5. Sedum.						
Rhodiola, *DC.* ...	11	II.	1′—1½′	Gr. Y.	July .	Pindari, Singjari.
crenulatum, *Hf. & T.*	12, 15,	II	2″—9″	.	..	Niti Pass, &c.,-
quadrifidum, *Pall.* .	17, 19	II.	2″—3″	R.	June, August	Patharkor, Pindari, Rákas tal, Rajhoti.
Himalense, *Don* .	20	II	.	...	..	?
elongatum, *Wall* .	10	II.	8″	.	August .	Sába ..
fastigiatum, *Hook f.*	18	II.	4′	Y.	July ...	Niti valleys in Gugé
asiaticum, *DC.* ...	13	II.	6″—12″	Y.	July .	Champwa, Barjikáng
var Wallichianum,	14	II	6″	.	August .	Milam ..
linearifolium, *Royle*,	8	II.	4″—6″	Y. Wh.	August	Rálam, Hardol Pass.
trifidum, *Wall.* ...	7	II.	6″	Wh.	August .	Naini Tal, Gori valleys, &c
rosulatum, *Edgew* ..	1	II	2″	W. Gr	April ..	Naini Tál, &c,
adenotrichum, *Wall*	4	II.	4″	...	.	?
trullipetalum, *Hf. & T*	21	II	2″	Y.	August	Barjikáng, Milam
Ewersii, *Ledeb* ..	9	II	6″—9″	R.	August ...	Milam, Niti, Gugé
multicaule, *Wall.* ..	3, 6,	II.	1″—6″	R. Y.	March, August	Almora, Naini Tal, Gori valley.
6. Sempervivum.						
acuminatum, *Dcne* .	3	II	1″—5″	...	..	Plains of Gugé.
mucronatum, *Edgew*	1	II.	6″		August ...	Malári, .
XLII.—DROSERACEÆ.						
1 Drosera.						
peltata, *Sm* ...	..	II.	8″	Wh	July ...	Almora, Jágesar

Plants—(continued).

Conditions of soil, &c		Elevation in feet above the sea	*Himálaya.*		Tibet.	Remarks.
			Rainy.	Dry.		
Open rocks	...	5—7,500	R	...	...	
Open	...	4—5,000	R.	...	...	
Do.	..	11—15,500	R	D.	...	= *Sedum* No 2, in Herb S & W.
Do	..	11,000	R.	.	...	
Do	..	14–17,000	R	D	T	
Do	...	10—16,000	R.	.	T	
..		?	...	...	.	
Woods	.	9,000	R	...	.	
Open		11—15,000	...	D.	T.	
Do.	..	12—14,500	R.	...	...	= *S. Rhodiola* in part.
Do	.	11,500	...	D.	...	
Do	.	9—12,000	R.	...		
On trees	...	7—8,500	R	...	..	
Banks	...	6—7,000	R	...	...	
..		?	R.		.	
Rocks	..	12—14,000	...	D	..	
Open	.	11—15,500	...	D	T	
Open wet	.	6—7,000	R.	..	...	
Open	...	15,500	...	...	T.	= *Crassula* No 2 in Herb. S. & W.
Do.	..	10.500	...	D.	...	
Open wet	...	4—8,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower.	Time of flowering.	Locality.
XLIII.—HALORAGEÆ						
1. Hippuris.						
vulgaris, *L* ..	...	H.	1′—1½′	Gr.	July ...	Raj-hoti, Gyanyima.
2. Myriophyllum.						
spicatum, *L* ...	..	H.	1′—2′	...	...	Naini Tál, &c.
XLIV.-COMBRETACEÆ						
1. Terminalia.						
belerica, *Roxb* ...	4	Tr	30′	...	...	Bhábar ...
Chebula, *Retz.* ...	1	Tr.	30′	Wh.	May ..	Sarju valley ...
tomentosa, *Bedd.* ..	...	Tr	30′	V Gr.	August ..	Sarju valley .
2. Anogeissus.						
latifolia, *Wall.* ...	...	Tr.	20′	...	August ..	Bhábar ...
3. Combretum.						
nanum, *Ham.* ...	...	S H.	1′—2′	Wh.	April ...	Bágesar Gangnáth
XLV.—MYRTACEÆ.						
1. Psidium.						
Guyava, *L.* ...	..	Tr.	10′—15′	...	February,	Outer hills ...
2. Eugenia.						
Jambolana, *Lam.* ...	1	Tr.	30′	Wh	March ...	Bhábar, outer hills.
sp—	2	Tr.	30′—40′	Wh.	December,	Ditto.
3. Careya.						
arborea, *Roxb* ...	...	Tr	30′	..	..	Bhábar ...
XLVI.-MELASTOMACEÆ						
1. Osbeckia.						
chinensis, *L.* ..	1	H.	2′	Pk	September,	Bagesar, &c. ...
stellata, *Wall.* ...	2	Sh.	3′	Pk	August .	Common ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himalaya.*		Tibet.	Remarks
		Rainy.	Dry.		
In water ...	15,000	..	...	T.	
Do. ..	4—6,500	R.	...	...	
Forest ...	1,000	R.	...	...	Not found in Herb. S & W
Do. ...	3,500	R.	..	..	
Do. ...	2,500	R	...	...	=*Pentaptera* No. 1 in Herb. S. & W
Do. ...	1—2,000	R	..	..	=*Conocarpus latifolia* in Herb. S. & W
Open ...	3—6,000	R.	...	...	
Cultivated ...	1—5,000	R.	.	. .	
Forest ...	1—3,000	R.	...	...	=*Syzygium Jambolanum* in Herb. S. & W.
Do. ...	1—2,000	R.	...	...	=*S. venosum, DC.* in Herb. S & W.
Do. ...	1—2,000	R.	...	...	
Open ...	3—5,000	R.	...	...	
Do. ...	4—6,500	R.	...	...	

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant	Colour of flower.	Time of flowering.	Locality.
XLVII.—LYTHRACEÆ						
1. Ammannia						
rotundifolia, *Ham.* ...	...	H.	3"—4"	Pk.	February,	Almora ...
salicifolia, *Monti.* ...	2, 3	H.	12"	...	...	Kosi river, Almora.
2. Woodfordia.						
floribunda, *Salisb.* ..	...	Sh.	8'—10'	Sc.	February,	Outer hills ..
3. Lagerstræmia						
parviflora, *Roxb.* ...	...	Tr.	40'—50'	Wh.	...	Bhábar ...
4. Punica.						
Granatum, *L.* ...	...	Sh.	8'—10	Sc.	June ...	Outer hills ...
XLVIII.—ONAGRACEÆ.						
1. Epilobium.						
angustifolium, *L* ..	2	H.	3'	Pk.	August ...	Níti, Rimkim,
latifolium, *L.* ...	1	H.	9"	Pr.	August ...	Milam, Badarinath
hirsutum, *L.* .	10	H.	3'	...	...	Naini Tál ..
var. lætum. ...	14	H.	...	...	...	Almora ...
roseum, *Schreb.* ..	5, 7, 9 11, 12, 13	H.	...	...	...	...
var. cylindricum ...	8	H.	...	..	..	Naini Tál ...
palustre, *L* ..	4	H	4"	Pk.	August ...	Laptel ...
origanifolium, *Lam* ...	6	H.	4"	Pk.	August ...	Milam ..
2. Circæa.						
lutetiana, *L.* ...	3	H.	8"	Wh.	July ..	Binsar ..
cordata, *Royle* .	1	H	1'—2'	Wh	August ...	Naini Tál, Kálimundi, &c.
alpina, *L.* ..	2	H.	4"	Wh.	August ...	Sába ...
XLIX.—SAMYDACEÆ.						
1. Casearia.						
tomentosa, *Roxb.* ...	...	T.	25'	GY.	February,	Bhábar ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya*		Tibet.	Remarks.
		Rainy.	Dry.		
Open	4—5,500	R.	...	...	=*Ameletia rotundifolia* in Herb. S. & W.
Open and by water	4,000	R.	...	...	No. 3 not found in Herb. S. & W.
Open	3—6,000	R.	...	...	=*Grislea tomentosa* in Herb. S. & W.
Forest	1,000	R.	..	..	
Open woods, cultivated.	1—5,500	R.	..	...	
Open	11,5—13,500	...	D	T.	
Do.	11,5—14,000	...	D.	...	
Woods	6,500	R.	...	...	
Open	5,000	R.	...	...	
...	...	.	...	...	
Woods	6,500	R.	...	...	
Open	15,000	.	.	T.	
Do.	13,000	...	D.	...	
Forest	7,000	R.	...	...	
Do.	7—8,000	R.	...	...	
Do	9,000	R	...	...	
Do.	1—2,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
L.—CUCURBITACEÆ.						
1. Trichosanthes.						
palmata, *Roxb.* ...	...	H. sc	10′	Wh.	July ...	Sarju valley, &c.
2. Herpestospermum.						
caudigerum, *Wall.* ...	...	H. sc.	6′	Y	August ..	Kalimundi Pass.
3. Cucumis.						
sativus, *L.*	1	H. sc	1′	Y.	August ...	Jalat ...
4. Zehneria.						
umbellata, Thun. ...	...	...	...	...	...	...
var. nepalensis	..	H. sc.	6′	Wh	May ...	Sarju valley ..
5. Melothria.						
odorata, *Hf. & T.* ..	...	H. sc.	10′	Y.	July ...	Almora ...
6. Gomphogyne.						
cissiformis, *Griff.* ..	...	H. sc.	6′	Gr. Y.	August ...	Kálimundi Pass
7. Gynostemma.						
pedata, *Bl* ...	...	H. sc	...	...	...	?
LI.—BEGONIACEÆ.						
1. Begonia.						
picta, *Sm.* ...	2	H.	8″	Pk.	August ..	Outer hills ...
amoena, *Wall.* ...	1	H	6″	Pk.	August ...	Naini Tál, Dágesar, &c.
LII.—DATISCACEÆ						
1. Datisca.						
cannabina, *L.* ..	...	H.	7	...	July ...	Almora ...
LIII.—FICOIDEÆ						
1. Mollugo.						
stricta, *L.* ...	...	H.	4″	Wh.	July ..	Naini Tál, &c.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.* Rainy.	*Himálaya.* Dry.	Tibet.	Remarks
Open ...	4,500	R.	...	...	
Do. ..	8,500	R.	...	...	=*Gymnopetalum pedunculosum* in Herb. S & W.
Do. ...	5,000	R.	...	...	
...	...	...	...	.	
Do. ...	6,500	R.	...	...	=*Karivia umbellata* in Herb S. & W.
Do. .	5,000	R	...	...	
Do. ..	5–8,000	R.	...	...	
...	?	...	...	...	=*Eukylia trigyna* in Herb. S. & W.
Wet banks ...	4—6,000	R.	...	...	
Trees & rocks,	7,000	R	...	...	
River-bed ...	4,000	R.	...	...	
Open ...	4—7,000	R.	...	...	

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering	Locality.
LIV.—UMBELLIFERÆ.						
1. Hydrocotyle.						
javanica, *Thnb.* ...	1	H, cr.	6″	...	March ..	Gágar Almora,
rotundifolia, *Roxb.* ...	3	H	3″	...	...	?
asiatica, *L* ..	2	H. cr.	6″	...	March ...	Kota-Dún, &c.
2 Sanicula.						
europæa, *L.* ...	...	H.	1′—1½′	...	May ..	Karim, Naíni Tál, &c
3. Vicatia.						
coniifolia, *DC.* .	1, 2	H.	6″—1½′	...	May ..	Chaur, Láhur..
4. Trachydium						
Roylei, *Lindl.* ...	...	H.	4″	Wh.	September,	Lanjar ...
5. Bupleurum.						
lanceolatum, *Wall.* ..	4	H.	3′—4′	Wh.	May .	Karim .
Candollii, *Wall.* ...	2	H.	2′	Br.	August	Rálam .
falcatum, *L.* ...	6	H.	3′—4′	..	February.	Outer hills .
var marginata ..	1	H.	2′—3′	Y.	May, ...	Sarju valley ...
longicaule, *Wall.* ...	3	H.	1′—2′	Br.	August ..	Rálam, Níti
tenue, *Don* ..	5	H.	2′—3′	...	September,	Naíni Tál, Gágar
6. Carum.						
carui, *L.* ...	...	H.	2′	Wh.	July ..	Tola .
anethifolium, *Benth.*	...	H.	12′	...	..	Naíni Tál, Almora,
Falconeri, *C. B. Clarke,*	...	H.	2′—3′	...	September,	Binsar ...
7. Pimpinella						
achilleifolia, *C. B. Clarke*	...	H.	...	...	...	?
acuminata, *C. B. Clarke*	...	H.	3′	Wh.	August ...	Naini Tál, &c.
tenera, *Benth.* ...	...	H.	1′—1½′	...	...	Naini Tál ...
diversifolia, *DC.* ..	1	H.	2′—4′	Wh.	August ...	Dudatoli, Naini Tál.
Stracheyi, *C. B Clarke.*	2	H.	9″	Wh.	June ..	Dhaoli river ...
cæspitosa, *Benth.* ...	..	H.	3″—4″	Wh.	July ...	Níti ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya*		Tibet.	Remarks.
		Rainy	Dry.		
By water ...	5—6,500	R.	..	...	
...	?	...	..	...	
Open ...	2—4,000	...	...	.	
Woods. ...	3,5—7,000	R.	..	..	
Near water, open.	6—9,500	R	...	...	
Open ...	10—17,500	...	...	T.	
Near water ...	6,500	R.	...	...	
Open ...	10,000	R	...	...	
Do. .	3—6,000	R.	...	..	
Do. ...	3,5—6,500	R.	...	...	
Do. ...	11—12,000	R	D.	..	
Do. ...	2,5—7,000	R.	...	...	
Do. ...	11,500	.	D.	...	
Do. ..	5—6,500	R.	...	...	=*Ptychotis* No 2 in Herb. S. & W.
Woods ...	7,000	R.	...	...	=*Ptychotis* No. 1 in Herb. S. & W.
...	?	.	...	...	=*Ptychotis* No. 3 in Herb S. & W.
Woods ..	7,000	R.	...	...	=*Reutera acuminata* in Herb. S. & W.
On oaks ...	8,500	R.	...	...	=*Acronema tenerum*, not found in S. & W.
Woods ...	5—9,500	R.	...	...	
On rocks ...	7,500	R.	...	...	
On rocks ...	12,000	R.	D.	...	=*Pohosciadium cæspitosum* in Herb. S. & W.

Name.	*Herbarium* number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower	Time of flowering.	Locality.
8. Osmorrhiza						
Claytoni, *C. B. Clarke.*	...	H.	1′—2′	...	May ...	Láhur ...
9. Chærophyllum.						
reflexum, *Lindl.* ...	...	H.	2′—3′	...	August ..	Jalat ...
10. Seseli.						
indicum, *W & A.* ...	...	H.	...	...	...	?
trilobum, *Benth.* ..	...	H.	2′—3′	Wh.	August ...	Milam, Níti ...
11. Œnanthe						
stolonifera, *Wall.* ...	2	H.	2′	Wh.	August ...	Almora ...
12. Selinum						
tenuifolium, *Wall.* ...	...	H.	1′—3′	Wh.	August ..	Naini Tál, Rálam, Milam.
var elata. ..	...	H.	1′—3′	Wh.	August ...	Naini Tál, Rálam, Milam
vaginatum, *C B. Clarke.*	...	H.	...	...	..	...
13. Cortia.						
Lindlei, *DC.* ...	1′2	H.	6″—9″	...	August ..	Rálam ...
14. Pleurospermum.						
Govanianum, *Benth*...	7 ?	H.	2′	Wh.	August ...	Rálam valley,
Candollii, *Benth.* ...	3	H.	12″	Wh.	August ...	Milam, Kalajawar
angelicoides, *Benth.* ...	...	H.	5′	Wh.	August ...	Rálam valley,
dentatum, *Benth.* ...	...	H.	...	...	...	?
stellatum, *Benth.* ...	...	H.	6″	Wh.	September,	Milam ...
Hookeri, *C. B. Clarke,*	...	H	9″	Wh.	August ...	Sholshol Rákastal.
Brunonis, *Benth.* ...	...	H.	9″	Wh.	August ...	Milam, Kálájawar.
15 Peucedanum.						
Dhana, *Ham.* ...	6	H.	...	...	...	Almora ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.* Rainy.	*Himálaya.* Dry.	Tibet.	Remarks.
Woods ...	7,500	R.	...	...	
Open ..	5,000	R.	...	..	
...	?	...	...	..	=*Cnidium diffusum* in Herb S & W.
Open ...	11,500	...	D.	...	=*Eriocycla nuda* in Herb S & W,
Near water ...	4,000	R.	...	...	Not found in Herb. S. & W.
Open ...	5,5—12,500	R.	D	...	=*Peucedanum* Nos 2 and 4 in Herb. S and W.
Do. ...	5,5—12,500	R.	D.	...	=*Selinum* No. 1 & *Peucedanum* No. 3
...	...	...	..	..	=*Peucedanum* No. 5 in Herb S. & W.
	12,500—14,500	R.	...	...	
...					
Open ...	8—11,000	R	...	...	
Do. ...	12—14,000	...	D.	...	=*Hymenolæna* No. 3 in Herb. S. & W.
Do. ...	8—11,000	R.	...	...	=*Angelica glauca* in Herb. S & W.
...	?	...	...	...	=*Hymenolæna* No. 1 in Herb. S. & W.
Do. ...	13,000	..	D.	...	=*Hymenolæna* No. 6 in Herb. S. & W.
Do. ...	15,500	...	...	T.	=*Hymenolæna* No. 4 and Oreocome 2 in Herb. S & W.
Do. ...	11—14,000	...	D.	...	=*Hymenolæna* No. 2 in Herb. S. & W.
Do. ...	5—6,000	R	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
16. Heracleum.						
Brunonis, *Benth.* ...	...	H.	1′—1½′	Wh.	August ...	Rálam, Milám,
candicans, *Wall.* ...	1, 2, 3	H.	3′	Wh.	May ...	Naini Tál, Rálam.
17. Caucalis.						
Anthriscus, *Scop* ...	...	H.	3′	R.	August ...	Naini Tál, Páton.
LV.—ARALIACEÆ.						
1. Aralia.						
cissifolia, *Griff.* ...	...	...	...	..	...	..
var scandens ..	1	S sc	...	...	May ...	Dwáli, Mádhári Pass
2. Pentapanax.						
Leschenaultii, *Seem.* ...	...	...	..	...	...	...
var umbellatum ..	3	Sh.	20′	...	May ..	Mádhári Pass, Dwáli.
3. Heptapleurum.						
impressum, *C. B. Clarke.*	...	Tr.	25′—30′	...	September,	Chami-binaik,
venulosum, *Seem.* ..	...	S. sc	30′—40′	...	March ...	Outer hills ..
4. Heteropanax.						
fragrans, *Seem.* ...	...	Tr.	20′	...	December,	Bhábar ...
5. Brassiopsis.						
aculeata, *Seem.* ...	...	Tr.	4′—8′	Wh.	February,	Sarju valley ...
6. Macropanax.						
oreophilum, *Miq.* ...	...	Sh.	6′	...	...	Naini Tál ...
7 Hedera.						
Helix, *L.* ...	1	S. sc.	30′—40′	Wh.	October ...	Bágesar, Naini Tál.
LVI.—CORNACEÆ.						
1. Marlea.						
begoniæfolia, *Roxb.* ...	...	Tr.	20′	...	June ...	Páton, outer hills.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	13,600	R.	D.	...	= *Tordyliopsis Brunonis* in Herb. S. & W.
Do. ...	6—11,000	R.	...	...	
Do. ...	5, 5—6,500	R	...	...	Probably = *Torilis Anthriscus* of list, which is not found in Herb Strachey, though *Caucalis Anthriscus* is there, named in manuscript without a printed ticket.
...	...	..	...	...	
Forest ...	8,600	R.	...	...	
...	...	.	...	...	
Do. ...	8—10,000	R	...	...	
Forest near water	10,000	R.	...	...	= *Hedera tomentosa* in Herb S & W.
Forest ...	1—3,000	R	...	...	= *Paratropia* and *Hedera* No. 6, in Herb. S. & W.
Do. ...	1,000	R.	...	...	= *Panax fragrans* in Herb. S. & W.
Do. ...	2, 5—4,000	R.	...	...	= *Hedera* No. 3 in Herb. S. & W.
Do ...	6,500	R.	...	...	= *Hedera* No. 5 in Herb. S. & W.
Do. ...	3—9,000	R.	..	...	
Open ...	3—6,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
2. Cornus.						
macrophylla, *Wall.*	2	Tr.	30′—40′	Wh	May	Naini Tál
oblonga, *Wall*	3	Sh	15′—20′	Wh	October	Common
capitata, *Wall.*	...	Tr.	20′	Y.	June	Pyura, &c.
LVII.—CAPRIFOLIACEÆ.						
1. Viburnum						
cotinifolium, *Don*	1	Sh.	15′	W Pk	May	Naini Tál, Dwáli.
stellulatum, *Wall.*	5	Sh.	12′	Wh	Do.	Binsar, &c.
var. ——	6	Sh.	15′	..	Do	Dudatoli
„ involucrata	7	Sh.	15′	Wh.	Do.	Káthi
punctatum, *Ham.*	3	Tr.	40′ – 50	Wh	Do	Sarju valley
coriaceum, *Bl.*	8	Sh.	15′	Wh	July	Common
erubescens, *Wall.*	2	Sh	15′	Wh. Pk	May	Káthi, Láhur ...
nervosum, *Don*	4	Sh.	15′ – 20′	Pk.	Do.	Mádhári Pass, Pindari.
2. Triosetum.						
hirsutum, *Wall.*	...	Sh	4′	...	July	Dugli
3. Abelia						
triflora, *Br.*	...	Sh.	10′	Wh.	May	Naini Tál, Malári.
4. Lonicera.						
hispida, *Pall.*	11	Sh.	10′	Y	June	Sagtea-deo Pass.
glauca, *Hf. & T.*	2	Sh.	2½′	Y.	July	Milam, Bompras.
asperifolia, *Hf. & T.*	6	Sh.	2½′—3′	Y.	Do.	Rimkim
angustifolia, *Wall.*	8?	Sh.	10′—12′	Pk. W	May	Námik, Káthi,
rupicola, *Hf. & T.*	5	Sh.	2½′	Pk.	July	Rimkim
✓ spinosa, *Jacquem.*	4	Sh.	2½′	Y.	Do.	Níti, Rimkim,
parvifolia, *Edgew.*	3	Sh.	2′	Y.	May	Pindari, Champwa.
obovata, *Royle*	1	Sh.	2′	Y.	July	Milam
quinquelocularis, *Hardw*	9	Sh.	12′	Y.	May	Naini Tál, &c.,
hypoleuca, *Dcne.* ✓	7	Sh.	5′-6′	Y.	June	Jelam
alpigena, *L*	10	Sh	15′-20′	Y. Pk.	July	Námik, Milam,
sinensis, *Dcne.*	14	S. sc.	20′	...	June	Almora
5. Leycesteria.						
formosa, *Wall.*	...	Sh.	6′-8′	W Pk.	May	Gágar, Binsar, &c

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himá-laya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Forest ...	5—7,500	R.	...	...	
Open & woods	4—7,000	R		...	
Open ...	5—7,000	R	...		=*Benthamia fragifera* in Herb. S. & W.
Forest ..	7—10,000	R.	.	...	
Do. ...	7 8,500	R	...	..	
Do. ...	8—9,500	R	...	...	
Do ..	7,500	R	..	...	
Do ..	4,000	R	...	..	
Open and woods	5—8,500	R	..	...	
Forest ..	7—9,000	R.	...	...	
Do ...	9,5—11,000	R	...	...	
Open rocks ...	10,500	R.	...	...	
Woods ..	6,—10,500	R.	D	...	
Open ...	11,000	R.	...	...	
Do. ...	12, 5—14,500	..	D.	...	
Do ...	13,500	.	...	T	
Forest ...	8—9,000	R.	...	.	
Open ..	13,500	...	.	T	
Do. ...	11,5—13,500	..	D.	T	
Do. ...	12,000	R.	...	...	
Do. ...	12,500	...	D.	...	
Open & woods,	3-7,000	R	...	..	
Open ...	9,000	..	D.	...	
Open & woods.	8, 5-11,500	R.	D	...	
Cultivated ...	5,500	R	..	..	
Forest ...	7-9,000	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality
LVIII.—RUBIACEÆ.						
1. Adina.						
cordifolia, *Hook.f.* ...	...	Tr.	60'	Wh.	January ...	Bhábar ...
2. Stephegyne.						
parvifolia, *Korth.* ...	...	Tr	40'	Wh.	Do. ..	Do. ...
3. Uncaria.						
pilosa, *Roxb.* ...	...	Sh.	...	...	June ...	Sarju valley ...
4. Hymenopogon.						
parasiticus, *Wall.* ...	...	Sh. P.	1'-2'	Wh.	July ...	Binsar, &c. ..
5. Hymenodictyon.						
excelsum, *Wall.* ...	2	Tr. P.	30'	...	...	Kálápathar, &c
flaccidum, *Wall.* ...	1	Tr. P.	20'	...	...	Mohargári ..
6. Wendlandia.						
exserta, *DC.* ...	1	Tr.	30'	Wh.	May ...	Bhábar, Bágesar
tinctoria, *DC.* ...	2	Tr.	15'	Wh	Do. ...	Bágesar ...
7. Argostemma.						
sarmentosum, *Wall.* ..	2	H.	3"	Wh.	August ...	Sarju valley ...
verticillatum, *Wall.* ...	1	H.	3"	Wh.	Do. ..	Do. ..
8. Clarkella.						
nana, *Hook.f.* ...	...	H.	2"—3"	Wh.	Do. ...	Mohargári ...
9. Hedyotis.						
stipulata, *Br.* ...	3	H.	12"	Wh.	Do. ...	Almora ...
10. Oldenlandia.						
Heynei, *Br.* ...	...	H	4"	Wh	Do. ...	Do. ..
gracilis, *DC* ...	...	H.	6"—9"	Br.	April ...	Do. ...
coccinea, *Royle* ...	...	H.	6"—15"		July ...	Binsar ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya.*		Tibet.	Remarks.
		Rainy	Dry.		
Forest	1,000	R.	...	...	=*Nauclea* No. 1 in Herb S. & W.
Do.	1,000	R.	...	...	=*Nauclea* No. 2 in Herb. S. & W.
Do.	2,500	R.	...	...	
On trees	6-7,500	R.	...	...	
Forest	2,500	R.	...	...	
Do.	4,000	R.	...	...	
Do.	1-3,000	R.	.	...	
Do.	2-3,000	R.	. .	...	
Wet banks	3—4,500	R	...	...	
Do.	3—4,500	R	...	..	
Do.	4,000	R.	..	...	=*Ophiorrhiza* No. 2 in Herb. S. & W.
Near water	4,000	R.	...	...	
Open	5,500	R.	...	...	=*Hedyotis* No. 2 in Herb. S. & W.
Do.	4 - 5,500	R.	...	...	=*Kohautia* No. 1 in Herb. S. & W.
Open grass	7,000	R.	...	..	=*Kohautia* No. 2 in Herb. S. & W.

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant	Colour of flower.	Time of flowering.	Locality.
11. Anotis.						
calycina, *Wall.* ...	...	H.	3″—6″	Wh	August ...	Naini Tál, &c.,
12. Ophiorrhiza.						
fasciculata, *Don* ...	...	H.	6″	Wh.	Do. ...	Mohargári ...
13. Adenosacme.						
longifolia, *Wall.* ...	...	H.	3′	Y.	Do. ...	Mohargári, Sarju valley.
14. Randia.						
tetrasperma, *Roxb.* ...	...	Sh.	2′—3′	Y.	May ...	Sarju valley ...
dumetorum, *Lam.* ...	...	Tr.	15′	Y.	Do. ...	Sarju valley *Bhábar*, *Bágesar.*
15. Gardenia.						
turgida, *Roxb.* ...	2	Tr.	30′	...	...	Bhábar ...
16. Knoxia.						
corymbosa, *Willd.* ..	...	H.	6″	...	August ...	Almora, &c ...
brachycarpa, *Br.* ..	...	...	12″-15″	Pk.	September,	Baijnáth ...
17. Pavetta.						
indica, *L.* ..	...	..	..	..	...	..
var. tomentosa ...	...	Tr.	15′	Wh.	June ...	Kota Dún, Sarju valley.
18. Coffea.						
bengalensis, *Roxb.* .	...	Sh.	2′-3′	Wh.	March ...	Bhábar ...
19. Hamiltonia.						
suaveolens, *Roxb.* ...	...	Sh	10′-12′	Bl.	October ...	Kálimat, Sarju valley.
20. *Leptodermis.*						
lanceolata, *Wall.* ..	1	Sh.	10′	Bl.	June ...	Binsar, &c. ..
sp. ——	2	Sh.	...	...	...	Dudatoli ...
21. Spermacoce.						
lasiocarpa, *Br.* ...	...	H.	12″	Wh.	September,	Almora ...
articularis, *L. f.* ..	2	H.	12″	...	Do. ...	Do. ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Shady banks ...	6—7,000	R.	...	...	=*Hedyotis* No. 1 in Herb. S. & W.
Wet rocks ...	4,000	R	...	...	=*Ophiorrhiza* No. 1 in Herb S. & W.
Woods ...	3—4,000	R.	...	...	
Open ...	4—6,000	R	...	...	=*Gardenia* No. 1 in Herb. S. & W.
Forest ..	1—3,000	R.	...	...	
Do. ...	1,000	R	...	...	
Open ...	4-500	R.	...	...	=*Spermacoce* No. 1 in Herb. S. & W.
Do. ...	4,000	R.	...	...	
...	...	...	...	...	
Forest ...	2-3,500	R.	...	...	
Do. ...	1-2,500	R.	...	...	
Open ...	2,5-6,000	R.	...	...	
Do. ...	5-8,000	R.	...	...	
Forest ...	10,000	R.	...	...	
By water ...	4,000	R.	...	...	=*Borreria lasiocarpa* in Herb. S. & W.
Open ...	4,000	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
22. Rubia.						
cordifolia, *L.* ...	1	H sc.	6′-10′	R.	July ...	Outer hills ...
Manjista, *Roxb* ...	2	H sc	8′	Gr.	Do. ...	Niti ...
Edgeworthii, *Hook (r)*	3	H. pr	6′	Y. Gr.	August ...	Sarju valley ...
23. Galium						
triflorum, *Michx.* ...	1	H.	6″—12″	Pk.	May ...	Naini Tál, Dwáli, Milam.
elegans, *Wall.* ...	2 & 8	H.	6″—2′	Wh	Do. & June	Naini Tál, Kálimundi, Rur Pass
Mollugo, *L.* ...	3, 5, 9,	H sc	2′—14′	R. Pk.	June, August.	Gori valley, Ramni, Binsar, Girgaon.
sp —— ...	4	H. sc	2′	...	August .	Binsar, Milam,
acutum, *Edgew.* ...	6	H sc	1′—2′	Y.	September,	Badarináth .
aparine, *L.* ...	7	H. sc	3′—5′	Y.	August ..	Rálam Níti ..
hirtiflorum, *Req.* ...	10	H. sc	3′	...	May ...	Almora ...
LIX.—VALERIANCEÆ.						
I. Triptostegia.						
glandulifera, *Wall.* ...	...	H.	1′—2′	Wh.	May ...	Kálimundi Pass,
2. Valeriana.						
Hardwickii, *Wall.* ...	1	H.	3′—4′	Pk.	August ..	Naini Tál, Rálam valley.
var.—— ...	2	H.	12″—15″	..	Do. ...	Milam, Níti ...
sp —— ...	3	H.	2″—3″	Pk.	July ...	Bomprás ...
sp. —— ...	4	H.	9″	..	...	Garhwál ...
Wallichii, *DC.* ...	5, 6	H.	9″—12″	Wh.	March, May	Almora, Naini Tál, Madhári Pass.
sp. —— ..	7	H.	6″	Wh.	May ...	Dwáli ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ..	5-7,000	R		..	
Do. ...	11,500	.	D	...	
Do ...	3,500	R	...	..	
Shade & open,	7—11,500	R.	D	...	
Do. & woods ...	5—11,000	R	...	...	
Shade & open...	5—8,000	R.	...	...	
Do. ...	7—11,000	R.	D.	.	
Open ...	10,000	.	D.	.	
Do ...	1—12,000	R.	D	...	
Do ...	9—11,000	R.	..	...	
Do. ...	5,000	R.	...	...	
Forest ...	9,000	R.	...	...	
Do. ...	6—8,500	R	...	...	
Open ...	11,500	...	D.	...	
Do. ...	14,500	...	D.	...	
...	?	...	...	...	
Do. ...	5—8,000	R.	...	...	
Do. ...	9,500	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
3. Nardostachys						
Jatamansi, *DC.* ...	1 & 2	H.	9″-1½′	Pk.	August ...	Rálam, Milam, Pindari
LX.—DIPSACEÆ.						
1. Scabiosa.						
Candolleana, *Wall*,	...	H.	1′	Wh.	April ..	Almora, &c ..
2. Dipsacus.						
inermis, *Coult.* ...	...	H.	4′-6′	Wh.	August ...	Binsár, &c. ..
3. Morina.						
longifolia, *Wall.* ...	1	H.	3′	Pk.	Do. ..	Rálam, Pindari,
persica, *L.* ...	2	H	2′	Y.	June ..	Naini Tál
Coulteriana, *Royle*,	3	H.	1½′	Y.	July .	Bampá .
LXI.—COMPOSITÆ.						
1. Vernonia.						
anthelmintica, *Willd.*	1	H.	3′	Pr.	August ..	Almora ...
cinerea, *Less.* ...	2	H.	2′	Pr.	Do. ..	Do., &c. ...
2. Adenostemma.						
viscosum, *Forst* ...	3	H.	2′	Wh	Do. ...	Gori river ..
var. elatum, *Don*,	2	H.	2′	Wh.	Do. ..	Almora ...
„ latifolium, *Don* .	1	H.	2′	Wh.	September,	Do. ...
3. Eupatorium.						
Reevesii, *Wall* ...	1	H.	3′	Wh.	October ..	Kálimat, Binsar,
cannabinum, *L.* ..	...	...	...	...	...	...
var indivisum ...	2	H.	3′	Y.	Do. ...	Sarju valley ...
4. Solidago						
Virga aurea, *L.* .	...	H.	3′-4′	Y.	September,	Almora, Naini Tál.

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open	12,5—13,500	R.	D.	...	
Do.	4—6,500	R.	...	...	
Woods	5—8,000	R.	...	...	
Open	11—12,000	R.	...	...	
Do.	8,000	R.	...	...	
Do.	10—11,000	...	D.	...	
Do.	5,500	R.	...	...	
Do.	2,5—5,500	R.	...	...	
Woods	5,000	R.	...	...	
Open	5,000	R.	...	...	
Do.	5,000	R.	...	...	
Forest	6- 7,000	R.	...	...	
...	...	..	...	. .	
Open	4,000	R.	...	...	
Woods	6—7,000	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
5. Dicrocephala.						
latifolia, *DC.* ...	1, 2	H.	8″–1½″	...	June ...	Naini Tál, Almora, &c.
6. Cyathocline.						
lyrata, *Cass.* ...	...	H	1′–1½′	Pr.	February,	Almora, &c. ...
7. Myriactis.						
nepalensis, *Less.* ..	2	H.	2′	W. Y.	August ...	Almora, Dwáli,
Gmelini, *DC.* ...	1	H.	1′–2′	Li.	Do. ...	Naini Tál, &c.,
8. Rhyncospermum.						
verticillatum, *Reinw.*	...	H.	2′	...	September,	Binsar ...
9. Aster.						
tricephalus, *C. B. Clarke.*	...	H.	2′	Bl	August ...	Milam, Naini Tal.
diplostephioides, *Benth.*	...	H	9″–12″	Bl.	Do. ...	Rálam ...
molliusculus, *Benth.*,	...	H.	1′	Li.	May ...	Common .
Thomsoni, *C. B. Clarke.*	...	H	1′–2′	Pk	August ...	Gangoli, &c ...
asperulus, *Nees* ...	...	H.	1′–2′	Pk.	Do ...	Rálam river . .
tibeticus, *Hook. f.* ...	...	H	9″	Li.	September,	Laptel ...
Stracheyi, *Hook f.* ...	...	H	2″	?	October ...	Pindari ...
10. Erigeron.						
acre, *L.* ...	...	...	...	. .	...	...
var monticola ...	4	H.	6″–9″	Bl.	August . .	Kálimat ...
„ alpinum ...	5	H.	9″	Bl	April . .	Bomprás ...
„ multicaule ...	2	H.	1′–2′	Wh.	August	Naini Tál, &c.
multiradiatum, *Benth.*	6	H.	1′–2′	Bl.	Do ..	Naini Tál, Dudátoli.
sp.—— ...	...	H	3″–8″	Li.	July ...	Kálájawar, Níti

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open near water	5—6,500	R	...	...	
Do ...	2—5,500	R	..	..	
Open ...	5—8,000	R	...	...	
Woods ..	5,5—10,000	R	...	..	
Do. ..	6,5—7,500	R.	..	...	=*Leptocoma racemosa* in Herb. S & W.
Open ...	7—11,500	R.	D.	...	=*Erigeron*, No. 3 in Herb S & W.
Do. ...	13,000	R.	...	...	=*Diplopappus* No. 6 in Herb. S. & W.
Do. ...	6,—8,500	R.	...	...	=*Diplopappus* No. 1 in Herb. S. & W
Woods ...	6,000	R.	...	...	=*Calimeris flexuosa* in Herb. S. & W.
Open ...	9,000	R.	...	...	
Do. .	15,000	..	..	T.	=*Diplopappus* No. 2 in Herb S & W.
Do. ...	12—12,500	R.	...	...	=*Heterochæta* No. 2 in Herb. S. & W.
...	...	...	...	...	
Open ...	5—7,000	R.	...	...	
Do. ...	14—16,000		D.	T.	
Woods ...	5,5—7,000	R.	..	...	
Forest ...	7—9,000	R.	...	...	
Open ...	14—17,000	...	D.	T.	=*Heterochæta* No. 1 in Herb. S. & W.

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
11. Microglossa.						
albescens, *C. B. Clarke.*	...	H. Sh.	2′—3′	Li.	August ...	Dugh, Tola ..
12. Conyza.						
japonica, *Less.* ...	3	H.	9″	Pk.	March ...	Almora, Naini Tál. ...
viscidula, *Wall.* ..	2	H. Sh.	3′—4′	Pk.	February,	Outer hills ...
absinthifolia, *DC.* ...	1	H	3′	Y.	August ...	Almora, Sába,
sp.—— ...	4	H	9″—12″	Bl.	Do. ...	Rajhoti, Rálam
13. Blumea.						
lacera, *DC* ...	4	H.	6″—9″	...	...	Almora .
laciniata, *DC.* ...	3	H.	3′	..	March ...	Do. ..
oxyodonta, *DC.* ...	7	H	..	...	...	Garhwál ...
aromatica, *DC.* ...	2	H.	3′	...	March ...	Bhábar ...
14. Laggera.						
alata, *Benth.* ...	...	H.	3′	Pk.	September,	Kapkot ..
pterodonta, *Benth.*	...	H.	4′—5′	Pk.	March ...	Outer hills ...
aurita, *Benth.* ? ..	...	H	...	.	...	?
15. Sphæranthus.						
indicus, *L.* ...	...	H.	6″	Pr.	April ...	Almora ...
16. Leontopodium						
alpinum, *Cass.* ...	1	H.	1″—1½″	...	August ..	Chor-hoti Pass,
sp. —— ...	2	H.	1″—1½″	...	Do. ...	Valleys in Gugé ...
„ ...	3	H.	6″	...	Do ...	Rálam ...
„ var. Stracheyi,	4	H.	1′—1½′	...	Do ..	Tola ...
17. Anaphalis.						
cinnamomea, *Benth.*,	9	H.	2′—3′	Wh.	September,	Binsar, Naini Tál
triplinervis, *Sims.*...	12	H	2′—3′	Wh.	August ...	Binsar ...
nubigena, *DC.* ..	10	H.	6″	Wh	Do. ..	Barjikáng, Topidhunga.
contorta, *Hook. f.* ...	3, 4, 8	H.	6″—1′	Wh.	Do ... September,	Gothing, Almora, &c

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	11—11,500	R.	D.	...	=Aster ferrugineus in Herb. S. & W.
Open, near water.	5—7,000	R.	...	...	
Do. .	4,000	R.	...	...	
Open, dry ...	5,5—8,500	R.	...	..	
Open, near water.	12—15,000	R.	D.	T	
Open ..	4,500	R.	...	...	
Do. ...	4—5,000	R.	...	...	
...	5,000	R.	...	...	
Open ...	1,000	R.	...	...	
Do. ...	3,500	R.	...	...	=*Blumea* No 6 in Herb S & W.
Do. ...	4—5,000	R	. .	...	=*Blumea* No. 1 in Herb. S. & W.
...	?	...	..	...	=*Blumea* No. 5 in Herb. S. & W.
Open, near water.	5,500	R.	...	...	
Open ...	16,000	...	...	T.	
Do. ...	15,000	...	...	T.	
Do. ...	11—13,000	R.	...	...	
Do. ...	11,500	...	D.	...	
Do. ...	6—8,000	R.	...	...	
Do. ...	7,5—8,000	R.	. .	...	
Do. ...	14,—15,000	...	D.	T.	
} Do. ...	5,—13,000	R.	D.	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
Anaphalis— (*contd.*)						
chionantha, *DC.* ..	2	H.	12″–15″	Wh.	September,	Tola, Milam,
var.—— ...	7	H.	6″	Wh.	Do. ...	Bagdwár ...
adnata, *DC.* ...	1	H.	1′–1½′	Wh.	Do. ..	Binsar, Naini Tál.
intermedia, *DC.* ...	11	H.	8″	Wh.	August ..	?
sp —— ...	5	H.	8″	Wh.	September,	Dhauli valley,
sp.—— ...	6	H.	6″	Pk.	June ...	Pindari ..
18. Phagnalon.						
niveum, *Edgew.* ...	...	H.	6″	...	June ...	Samangentha. .
19. Gnaphalium.						
hypoleucum, *DC.* ...	3	H.	1½′	...	May ...	Almora, Káthi,
luteo-album, *L.* ...	2	H	1′	Y.	March ...	Do. .
indicum, *L.* ...	1	H.	1′	Y.	Do. ...	Do. ..
20. Cæsulia.						
axillaris, *Roxb.* ...	...	H.	6″–9″	...	September,	Kota, Retagár,
21. Inula.						
vestita, *Wall.* ...	4	H.	1′	Y.	March ...	Almora, Hardwár.
nervosa, *Wall.* ...	3	H.	2′	Pk	September,	Kapkot, Naini Tál
barbata, *Wall.* ...	5	H.	2′	Y.	August .	Rálam river ..
Cappa, *DC.* ...	1	H.	3′–4′	...	March ...	Pyura, &c. ..
cuspidata, *Hf. & T.*,	6	Sh.	4′–5′	Y.	February,	Almora, Naini Tal.
sp.—— ...	2	H.	2½′	Y.	...	...
22. Vicoa.						
auriculata, *Cass.* ...	...	H.	6″–8″	Y.	March ...	Almora ..
23. Carpesium.						
cernuum, *L.* ...	1	H.	3′	Gr Y.	August .	Naini Tál ...
var pedunculosum,	..	...		...	.	..
abrotanoides, *L.* ...	3	H.	2′	...	August ...	Mohargári Pass, Binsar.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry		
Open	12,000	..	D.	...	
Do.	8,000	R.	..	...	
Do	6—7,500	R.	..	...	
Do.	?	.	.	...	
Do.	9,000	R	D.	..	
Do	10,500	R	..	.	
On rocks	7,000	R	D.	...	
Open	3,5—8,000	R.	..	...	
Do	5,500	R.	..	...	
Do.	1,600	R	.	..	
Rice fields	2—3,500	R.	...	...	
Open	1—4,000	R	..	...	
Do.	3,5 - 7,000	R	...	...	
Do.	8,5 10,000	R	...	...	
Do.	4,600	R	..	...	
Woods	5—7,000	R.	...	.	
...	...	...	...	...	
Open	4,000	R.	..	...	
Woods	7,000	R	..	...	
...	...	...	...	.	
Woods	6 - 7,500	R.	.	...	

List of Kumaon

Name	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower.	Time of flowering.	Locality.
24 Adenocaulon						
bicolor, *Hook.* ...	...	H.	3′	Wh	September,	Páton ..
25 Xanthium.						
Strumarium, *L.* ...	...	H.	2′	...	June ..	Almora, &c. ..
26. Siegesbeckia.						
orientalis, *L.* ...	...	H.	2′	Y.	August ...	Jalat ...
27. Eclipta.						
alba, *Hassk.* ..	...	H.	1½′	...	March ..	Almora, Naini Tál. ..
28 Blainvillea.						
latifolia, *DC.* ...	...	H.	2′	...	July ...	Do. .
29 Bidens.						
tripartita, *L.* ...	3	H.	1′–2′	Wh	August .	Almora, &c ...
pilosa, *L.* ...	2	H.	2′–4′	Wh.	February,	Rámganga river, &c
decomposita, *Wall.*,	1	H	4′	Y.	August ...	Almora, &c
30 Galinsoga.						
parviflora, *Cav.* ...	...	H.	6″–12″	Wh.	All the year.	Do ..
31. Allardia.						
glabra, *Dcne.* ...	1	H.	2″	Wh.	July ...	Chorhoti Pass,
tomentosa, *Dcne.* ...	3	H	4″–5″	Pk.	August ...	Milum, &c. .
	2	H.	3″	Pk.	Do.	Balchha Pass...
32. Chrysanthellum.						
indicum, *DC.* ...	...	H.	4″–5″	Y.	September,	Hawalbágh ...
33. Cotula.						
hemisphaerica, *Wall.*,	...	H.	6″	Y.	March ...	Pátli Dún ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himálaya.* Rainy.	*Himálaya.* Dry.	Tibet.	Remarks.
Forest ..	7,000	R	...	...	
Open ..	5,500	R	...	...	
Forests ...	5—8,500	R.	..	...	
Open ...	5,500	R	..	..	
Do. ...	5—6,500	R	..	...	
Do ...	4,000	R.	...	..	
Do. ..	3—7,000	R	.	...	
Do. ...	4—6,000	R	...	...	
Naturalized in gardens.	5—6,000	R.	...	...	
Open ..	16,500	..	..	T	
Do	13—15,000	.	D.	T.	
Do. ..	16—17,000	...	...	T	
Do. ..	4,000	R.	...	...	
Do. ...	2,500	R.	...	...	= *Machlis hæmispherica* in Herb. S & W.

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower	Time of flowering	Locality.
34. Tanacetum.						
nubigenum, *Wall* .	2	H.	1′	Y.	September,	Pindari, Tungnáth.
tibeticum, *Hf & T*,	3	H.	1′	Y.	August . .	Milam ...
longifolium, *Wall.*	1	H.	2′	Y.	September,	Pindari, Tungnáth.
tomentosum, *DC* ...	4	H	1′	Y.	August . .	Gothing ...
gracile, *H. f & T*....	16	H.	...	. .	September,	Satlaj river in Gugé
35 Artemisia						
scoparia, *W. & K.* . .	1	H.	3′	...	August ...	Háwalbágh ...
stricta, *Edgew.* . .	11	H	...	...	Do ...	Milam, Shelong.
maritima, *L.* ...	5	H.	2′	...	Do. ...	Jelam ...
vestita, *Wall.* .	4	H	3′	...	Do. ...	Common ...
sacrorum, *Ledeb.* ...	15	H.	...	...	September,	Satlaj river in Gugé.
var. —— ...	6	H	2′	Br.	August ...	Tola, Milam .
vulgaris, *L.* .	2, 8, 0, 14	H.	1′—3′	...	Do. ...	Almora, Kedárnath.
Roxburghiana, *Bess*, var, grata ...	3, 7	H.	3′	Br.	Do. ...	Binsar, Rálam valley.
fasciculata, *Bieb* ..	17	H.	...	...	September,	Satlaj valley in Gugé.
hypoleuca, *Edgew.* ...	12, 13	...	...	...	August ...	Milam, Shelong, Satlaj valley in Gugé, Badarináth.
Stracheyi, *Hf & T.*,	19	H.	1′	Y	September,	Manasarowar .
macrobotrys, *Ledeb.*	18	H	...	...	Do.	Milam, Topidhunga.
sp —— ...	...	...	...	. .	...	...
36 Tussilago.						
Farfara, *L.* ...	...	H.	6″—12″	Y.	May ...	Dwáli Pindari,
37 Doronicum.						
Roylei, *DC.* ...	...	H.	1½′	Y.	August ...	Tungnáth ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	12,000	R.	...	...	
Do. ...	13,000	...	D	T.	
Do ...	12,000	R.	..	...	
Do ...	13,500	...	D	...	
Do. ...	13,500	...	..	T.	
Do ...	4—11,500	R	D.	...	
Do. ...	11—12,000	..	D.	..	
Do. ...	9,000	R	...	...	
Do. ...	6,000	R	..	...	
Do. ...	12—13,500	..	D.	T,	
Do. ...	11,500	..	D.	...	
Do. ...	1—11,500	R.	...	..	
Do. ...	7—9,000	R.	...	...	
Do. ...	13,000	...	...	T	
Do. ...	11—13,500	...	D.	T.	=A Roxburghiana, Bess.
Do. ...	14-15,500	...	...	T.	
Do ..	11—15,000	...	D	T.	
...	...	...	...	...	
Open, débris ...	8—11,500	R	...	...	
Woods ...	10,000	R.	...	...	=*D. Pardalianches* in Herb. S. & W.

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant	Colour of flower	Time of flowering.	Locality.
38 Gynura.						
nepalensis, *DC.* ...	...	H.	3′	Or.	March ...	Outer hills ...
39 Emilia.						
sonchifolia, *DC.* ...	...	H.	1′	Pk.	April ...	Almora ..
40 Senecio.						
alatus, *Wall.* ...	8	H.	2′	Y.	August ...	Naini Tál, Káthi, Rálam
rufinervis, *DC.* ...	7	H.	2′	Y.	July .	Naini Tál, Káthi
Kunthianus, *Wall.*,	5	H	1′—1¼′	Y.	August ...	Rálam river ...
Candolleanus, *Wall*,	6	H.	1½′—2′	Y.	Do. ...	Pindari ...
graciliflorus, *DC.*,	3	H	5′	Y.	Do. ..	Pindari, Rálam,
chrysanthemoides, *DC*	10	H	1′	Y.	July ...	Gothing ...
diversifolius, *Wall*,	4	H.	3′	Y	August ...	Binsar, &c. ...
nudicaulis, *Ham.* ..	2	H.	12″—18″	Y.	July ...	Almora, &c
coronopifolius, *Desf*	9	H.	2″	Y.	September,	Rákas Tál, Shelshel
pedunculatus, *Edgew.*	1	H.	9″—12″	Y.	July	Malári, Níti.
Ligularia, *Hook f* ..	...	H.	4′	Y.	August ...	Rálam river, Dudatoli
arnicoides, *Wall.* ..	...	H.	6″	Y.	Do. ...	Rájhoti, Chorhoti, and Níti Passes.
41. Werneria.						
nana, *Benth.* ...	...	H	4″	Y.	Do. ..	Rájhoti and Chorhoti Passes.
42 Echinops.						
cornigerus, *DC.* ...	1	H.	2′	Bl.	Do. ...	Bhim-udiyár, Malári
niveus, *Wall.* ...	2	H.	2′	Bl	February,	Almora, &c. ...
43 Carduus.						
nutans, *L.* ...	...	H.	...	...	...	...
var lucida ...	...	H	5′	Pr.	August ...	Rálam ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.* Rainy.	Dry	Tibet	Remarks.
Open ...	2,5—4,000	R.	...	...	
Do ...	5,000	R.	...	...	
Do ...	8—11,500	R.	...	...	
Woods ...	7—8,000	R	...	...	
Open ...	11—13,000	R	...	...	
Do. ...	11,000	R.		...	
Woods ...	9—11,000	R	...	...	
Open ...	13,000	..	D	..	
Do. ...	5—9,000	R	...	...	
Do. ...	4—5,500	R	...	...	
Do. ...	14—16,000	...	..	T.	
Do. ...	10—11,500	..	D.	...	
Do. ...	8—9,000	R.	...	...	= *Ligularia* No 2 in Herb. S. & W.
Do. ...	15—17,000	...	...	T.	= *Ligularia* No. 4 in Herb. S, & W.
Do. ...	16—17,000	.	...	T.	*Ligularia* No. 8 in Herb. S. & W.
Do. ...	9,000	R.	D	...	
Do. ...	4—5,000	R	...	..	
Fields ...	12,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Height of growth.	Habit of plant.	Colour of flower.	Time of flowering.	Locality.
44 Cnicus.						
arvensis, *Hoffm.* ...	...	H.	2'	Pr.	March ..	Outer hills ...
eriophorus, *Hoffm.*,	...	...	...	...	...	...
involucratus, *DC.*...	...	H.	6'	Pr W.	August ..	Jalat, Rálam river.
var. horrida ...						
argyracanthus, *Benth.*	...	H.	5'	Pr. W.	April ..	Naini Tál, Rálam.
var nepalensis ...	...	H.	6'	Pr. W	August ...	Do. ..
Wallichii, *Benth.* ...	...	H.	6'	W.	Do. ..	Lohathal, Almora.
45. Saussurea.						
obvallata, *Wall.* ...	4	H.	1'—2'	Pr.	Do. ...	Pindari, Barjikáng Pass.
bracteata, *Dcne.* ...	2	H.	3"- 6"	Pr.	Do. ...	Balchha Pass, Lanjar.
Kunthiana, *Wall.*...	8	H.	2"- 3"	...	Do. ..	Rálam, Kálajawar.
sorocephala *H.f. & T.*	5	H.	2"—3"	Pr.	Do. ...	Balchha Pass ..
gossypiphora, *Don*...	1	H.	2"—6"	Pr	Do. ..	Bárjikáng, Kedárnath
graminifolia, *Wall*,	3	H.	3"—9"	Pr.	Do. ...	Barjikáng Pass,
Candolleana, *Wall* ..	13	H	3'	Pr.	Do. ..	Pindari .
piptathera, *Edgew*,	12	H.	3'	Pr.	Do ..	Do ..
candicans, *Clarke* .	...	H.	1'—2'	Pk.	March ...	Hawalbágh, Naini Tál
albescens, *Hf. & T.*,	15	H	5'	...	August ...	Josimath, Gágar
denticulata, *Wall.*...	11	H.	4'	Pr. Br.	Do. ...	Dwáli, Rálam, Níti
hypoleuca, *Spreng.*,	...	H.	4'	..	Do ...	Jalat, &c. ...
deltoidea, *Clarke* ...	...	H.	6'	Pr.	Do. ...	Do. .
sp. —— ...	6	H.	1"—2"	Pr	Do ...	Unta-dhura ...
,, —— ...	7	H	3"—6"	Pr.	Do. ...	Balchha Pass...
,, —— ...	9	H	1'	...	Do. ...	Plain of Gugé,
,, —— ...	10	H.	4"—6"	...	Do. ..	Gothing ...
46. Jurinea.						
macrocephala, *Benth.*	...	H	1'	Pr.	Do. ...	Rálam, Pindari.
47. Serratula.						
pallida, *DC.* ...	...	H	1½'—2'	Pr.	June ...	Binsar, Gágar,

Plants—(continued).

Conditions of soil, &c.		Elevation in feet above the sea.	*Himá laya*		Tibet.	Remarks.
			Rainy.	Dry		
Fields	...	1—3,000	R.	...	...	= *Cirsium* No. 4½ in Herb. S & W.
...		...	.	...	...	
Open	..	9—10,000	R	...	...	= *Cirsium* No. 3 in Herb S. & W.
Do.	...	4,5—7,500	R.	...	...	= *Cirsium* No. 2 in Herb. S & W.
Do	..	7—11,500	R	...	...	= *Cirsium* No 1 in Herb S & W.
Do.	...	3—7,000	R	...	...	= *Cirsium* No. 4 in Herb S. & W.
Do.	...	12,5—15,000	R.	...	...	
Do.	...	16—17,000	...	..	T	
Do.	...	12,5—15,000	R.	D.	...	
Do	...	16—17,000	...	...	T.	
Do.	...	12—14,500	R.	...	...	
Do.	...	13—14,000	R.	D.	...	
Do.	...	12,500	R	...	...	
Do.	...	12,500	R	...	...	
Banks	...	4—7,000	R.	...	...	= *Aplotaxis* No. 2 in Herb. S. & W.
Open	...	6,500	R.	...	...	
Do.	...	7—10,000	...	D.	...	
Do.	...	6—7,000	R	...	...	= *Aplotaxis* No. 6 in Herb. S & W.
Do.	...	6—7,000	R	...	...	= *Aplotaxis* No. 5 in Herb. S & W.
Do.	...	16,000	...	...	T.	
Do.	...	16,000	...	...	T.	
Do.	...	16 000	..	.	T.	
Do.	...	13,500	R.	D.	...	
Do.	...	12,000	R.	...	...	= *Dolomiæa macrocephala* in Herb. S. & W.
Do.	...	5,5—7,500	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower.	Time of flowering.	Locality.
48. Tricholepis						
furcata, *DC.* ...	1	H	2′—3′	...	September,	Hardol Pass ...
elongata, *DC.* ...	2	H.	4′	Buff	July ..	Almora ...
49. Carthamus.						
tinctorius, *L.* ...	...	H.	3′	Sc.	March ...	Outer hills ...
50. Leucomeris						
spectabilis, *Don* ...	...	S. Tr	10′—20′	Wh.	May ...	Do. ...
51. Ainsliæa.						
pteropoda, *DC.* ...	1	H.	1½′	Pk.	March ...	Naini Tál, &c.,
aptera, *DC.* ...	2	H.	2′—3′	Wh	Do ...	Gágar, &c. ...
52 Gerbera.						
lanuginosa, *Benth.*,	...	H.	6″—8″	Pk.	Do. ...	Naini Tál, &c,
macrophylla, *Wall.*,	...	H.	2′	Wh	December,	Binsar, &c. ...
53 Picris.						
hieracioides, *L.* ...	...	H	1½′—2′	Y.	August ..	Tola, Níti, Byánsi.
54. Crepis.						
fœtida, *L.* ...	...	H.	6″—8″	Y.	April ..	Almora, &c.
japonica, *Benth.* ...	...	H.	2′—3′	Y.	February,	Outer hills ...
glauca, *Benth.* ...	...	H.	6″	Y.	September,	Milam, Níti ...
glomerata, *Dcne.* ...	...	...	...	...	...	Barjikáng Pass
55. Taraxacum.						
Dens-leonis, *Desf.*,	...	...	...	...	...	...
var. eriopodum ...	2	H.	3″—4″	Y.	All the year.	Rálam, Naini Tál.
„ parvulum ...	1	H.	2″	Y.	Do. ...	...
„ —— ...	3	H.	6″	Y.	August ...	Níti ..
„ —— ...	4	H.	1″	Y.	Do. ...	Kyangar Pass,

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himálaya* Rainy.	*Himálaya* Dry.	Tibet.	Remarks.
Open ..	8,000	R.	...	..	
Do. ...	5,500	R	...	...	
Cultivated ...	1—4,000	R.	...	...	
Dry, open ...	3—5,000	R	..	...	
Woods ...	6—7,000	R.	.	..	
Do ...	6,5—7,500	R.	...	..	
Open rocks ...	6 5—8,500	R.	...	..	=*Oreoseris lanuginosa* in Herb. S. & W.
Open ...	6,5—7,500	R.	..	...	=*Bernera nepalensis* in Herb. S. & W.
Do ...	7,5—11,500	R	D.	...	
Do. ...	5—7,000	R	...	...	=*Barkhausia fœtida* in Herb. S & W.
Do. ...	1—5,500	R.	...	...	=*Youngia* No 1 in Herb S. & W.
Do. ...	11—12,500	...	D	.	=*Youngia* No. 2 in Herb. S & W.
Do. ...	14,000	..	...	..	
...	...	...	..	...	
Do. ...	7—10,000	R.	D.	...	
Do. ...	5—10,000	R.	...	...	
Do. ...	11,500	...	...	T.	
Do ...	10,000	...	...	..	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
56. Lactuca.						
obtusa, *Benth* ...	...	H.	1'–1½'	Y.	February,	Almora, &c. ..
dissecta, *Don* ..	3	H.	1'—2'	Pr	April ...	Almora ..
longifolia, *DC* ..	2	H.	2'	Pr.	August ...	Ramganga valley, Almora.
sagittarioides, *C. B. Clarke* .	1,4	H.	1'—1½'	Pr	August ...	Gangoli ..
Brunoniana, *Wall.*,	...	H	2'—3'	Li.	August .	Kálimundi .
graciliflora, *DC* ..	..	H	1'—2'	Bl	August ..	Rálam, Milam,
macrorhiza, *Hook. f.*,	...	H.	1'—2'	Bl	August ..	Rálam, Níti ...
var. saxatilis ..	...	H	1½'	Bl.	August ...	Níti ...
Lessertiana, *Wall* ...	..	H.	1½'—3'	Bl.	August ..	Níti, valleys of Gugá, Rálam,
Dubyæa, *Benth* ...	...	H	3'	Y.	August ..	Sába, Pindari,
sp —— ..	...	H.	2'	Y.	May ...	Sarju valley ..
57. Sonchus.						
asper, *Vill.* ..	2	H	3'	Y.	February,	Outer hills ...
arvensis, *L.* ..	1	H	3'—4'	Y.	February,	Ditto ...
58. Tragopogon.						
gracile, *Don* ...	...	H	6"—9"	Y.	April ...	Almora ...
LXIII.—CAMPANULACEÆ.						
1. Lobelia						
Wallichiana, *H.f. & T.* .	1	H,	4'	Pk.	February,	Naini Tál ...
pyramidalis, *Wall*,	2	H.	6'	Pr	October ...	Nánik, Jagesar,
trialata, *Ham.* ..	3	H	4'	..	September,	Dhanpur ...
2. Cephalostigma.						
hirsutum, *Edgew* ...	...	H.	1"—2"	...	...	Almora ...
3. Wahlenbergia						
gracilis, *DC* .	2	H,	6"	Bl.	March ...	Almora ...

Plants—(continued).

Condition of soil, &c	Elevation in feet above the sea.	*Himá-laya.*		Tibet.	Remarks.
		Rainy.	Dry		
Open .	4—5,500	R.	..	...	= *Microrhynchus* No. 1 in Herb. S. & W.
Do. ...	5,550	R.	..	..	
Do .	4—5,500	R.	..	..	
Do. ..	5,500	R.	.	.	= *Melanoseris* No. 4½ in Herb. S & W.
Forest . .	7,5—9,000	R	...	...	= *Prenanthes* Nos. 1 & 3 in Herb S & W
Open . .	12,000	R.	D.		= *Mulgedium graciliflorum* in Herb. S & W.
Open rocks ..	7—11,500	R.	D.	..	= *Melanoseris* No. 1 in Herb S & W
Open ...	11,500	..	D.	.	= *Melanoseris* No 4 in Herb S & W
Open rocks . .	12—16,000	...	D	T	= *Melanoseris* Nos 2 & 3 in Herb. S. & W
Open ...	9—12,500	R.	.	...	= *Dubyæa hispida* in Herb S & W.
Do. ...	4,000	R.		...	= *Microrhynchus* No. 2 in Herb. S. & W.
Do. ...	1—5,500	R.	...	..	
Do. . .	1—5,500	R.	...	...	
Do. ...	5—6,000	R	.	.	
Do ...	5—6,000	R.	.	.	= *L. pyramidalis* in H. Ind. ill., p. 426.
Forest ...	6—7,000	R	...	. .	
Fields ...	6,000	R.	...	. .	
Open ...	5,000	R.	.	...	
Do. ...	5,000	R.	...	.	= *Campanula* No. 11 in Herb. S. & W.

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
3. Wahlenbergia.—(*concluded*).						
peduncularis, *A.DC.*	3	H.	4″	Li.	May ...	Chaur ...
sp —— ...	1	H.	3″—4″	...	...	...
4. Codonopsis.						
purpurea, *Wall.* ...	1	H. sc.	3′	Pr.	August ..	Laháthal ..
lurida, *Lindl* ...	2	H sc	4′	Pr. Gr.	August ..	Rálam river ..
viridis, *Wall* ...	3	H sc.	10′	Gr Br.	August ..	Rathi, Kálimundi Pass.
5. Cyananthus.						
lobatus, *Wall* ...	1	H.	12″	Bl,	August ...	Pindari, Rálam
linifolius, *Wall.* ...	2	H	6′	Bl	August ..	Ditto ...
integer, *Wall* ...	3	H.	9″	Bl.	August ...	Rui Pass ...
6. Campanula.						
latifolia, *L.* ...	1	H.	3′	Pr.	August ...	Kálimundi Pass, &c.
argyrotricha, *Wall.*,	2	H.	3″—4″	Bl.	August ...	Champwa, Niti
aristata, *Wall.* ...	3	H.	8″	Bl.	August ...	Sháigchá, Milam
cana, *Wall* ...	4, 7	H.	6″—10″	Bl.	August ...	Naini Tál ...
carnosa, *Wall* ...	5	H	6″	Bl.	May ...	Madhári Pass
cashmiriana, *Royle*,	6	H.	8″	Pk.	August ...	Milam, Niti ...
ramulosa, *Wall.* ...	9	H.	2′	Bl.	August ...	Laháthal, &c,
sylvatica, *Wall.* ...	10	H.	9″—12″	Bl	August ...	Binsar, &c. .
canescens, *Wall.* ...	12	H.	10″	Bl	March ...	Almora ...
colorata, *Wall* ...	13	H.	1′—2′	Bl.	March ..	Almora ...
LXIV.—ERICACEÆ.						
1. Gaultheria.						
trichophylla, *Royle.*	1	Sh.	3″—4″	Pk.	June ...	Mádhári Pass,
nummularioides, *Don* ...	2	Sh.	9′	Pk.	June ...	Láhúr ...
2 Cassiope.						
fastigiata, *Don* ...	...	Sh,	1′	Pk.	June ...	Pindari, &c. ...
3. Andromeda.						
ovalifolia, *Wall.* ...	3	Tr.	20′	Wh.	June ..	Naini Tál, &c,
villosa *Wall.* ...	2	Tr.	20′	Wh.	June ...	Rogila ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himálaya.*			Remarks.
		Rainy.	Dry.	Tibet	
Open ...	6—7,000	R.	...	...	=*Campanula* No. 8 in Herb S. & W.
...	...	R.	...	...	
Do. ...	6,000	R	...	...	
Do. ...	10,000	R	...	...	=*C. rotundifolia, Benth?*
Do ...	6,5—7,000	R.	...	...	
Do. ...	10—12,000	R.	...	...	
Do. ...	12—13,000	R.	...	...	
Open rocks ...	10—11,000	R.	...	...	
Open ...	8,5—11,000	R	D.	...	
Do. ...	8—11,000	R.	D.	...	
Do. ...	13—15,000	...	D.	T.	
Do. ..	7—8,000	R	...	...	
Forest ...	8,500	R.	...	...	=*Peracarpa carnosa, H. F. & T.*
Open ...	12—13,000	...	D.	...	
Do. ..	6—12,000	R.	...	...	=*C. colorata* No. 13
Do. ...	5—7,000	R.	...	...	
Do. ..	5,500	R.	...	...	
Do. ...	5—8,000	R.	...	...	
Open banks ...	10—12,000	R.	...	...	
Do. ...	7,5—10,000	R	...	...	
Open ..	11—14,500	R.	D.	...	
Forest ...	5—9,000	R.	...	...	=*Pieris* No. 1 in Herb. S. & W.
Do. ..	10,000	R.	...	...	=*Ditto* No. 2 in Herb. S. & W.

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
4. **Rhododendron.**						
lepidotum, *Wall.* ...	1	Sh.	1″—1½″	Pk.	June ..	Pindari, Bompras.
anthopogon, *Don* ...	2	Sh.	1′—2′	Y.	June ..	Ditto ...
campanulatum, *Don*,	3	Sh.	10′	Li.	May ...	Pindari, &c ..
nobile, *Wall* ...	4	Sh.	8′	...	...	Champwa ...
? ...	5	Tr.	20′	R.	May ..	Jhuni ...
barbatum, *G. Don*,	6	Tr.	20′—25′	R	May ...	Mádhári Pass,
arboreum, *Sm.* ...	...	..	..	..	...	...
var roseum ...	7	Tr.	25′	R.	May ...	Námik ...
,, puniceum ...	8	Tr.	25′—40′	R	May ..	Naini Tál, &c.,
LXV.—PRIMULACEÆ.						
1. **Primula.**						
speciosa, *Don* ...	1	H.	1′—1½′	Pr.	January ...	Almora, &c. ...
denticulata, *Sm.* ...	2	H.	1′	Pr	March ...	Naini Tál, &c.,
capitata, *Hook* ...	3	H.	9″	Pr	May ..	Pindari, Rajhoti.
Stuartii, *Wall* ..	4	H.	1′—2′	Pr	June ...	Pindari, &c. ...
Moorcroftiana, *Wall.*,	5	H	3″—4″	Pr	July ..	Niti Pass ..
sibirica, *Jacquem.* ..	6	H.	1′—1½′	Pr.	July ...	Pindari, Níti, &c.
var tibetica ..	15	H	1″	Pr	September,	Gyanima ...
floribunda, *Wall.* ...	7	H.	4″—6″	Y.	January ..	Naini Tál ...
pulverulenta, *Edgew.*,	8	H.	6″	Pr.	April ..	Mádhári Pass,
nana, *Wall.* ...	9	H.	6″	Pr.	May ..	Champwa, Pindari.
sulphurea, *Hook f.*...	10	H.	3″	Pr.	February,	Suring ...
petiolaris, *Wall.* ...	11	H.	4″—6″½	Pr	May ...	Mádhári pass...
autumnalis, *Hook f.*	12	H.	4″	Pr.	October ...	Námik ..
Stracheyi, *Hook. f*	13	H.	½″	Pr.	August ...	Barjikang Pass,
minutissima, *Jacquem.* ...	14	H.	¼″	Pr.	July ...	Barjikáng Pass, Bomprás.
2. **Androsace.**						
rotundifolia, *Hardw.*,	1	H.	3″	Wh.	February,	Plains, Bágesar
incisa, *Wall* ...	2	H.	3″	Pk	May ..	Almora ...
lanuginosa, *Wall.*...	3	H.rn	3″	Pk	May ...	Naini Tál ...
sarmentosa, *Wall.*...	4	H.rn.	6″—9″	Pk.	July ...	Ralam, &c. ...
Jacquemontii, *Duby*,	5, 10	H rn.	1″—3″	Pk. Pr	August ..	Topidhunga Langar.
pedicillata, *Royle* ...	6	H.	6″	Pk	May ...	Dwáli ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himá-laya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	9—14,000	R.	D.	...	
Do. ...	10—14,000	R	D.	...	= *Osmothamnus* in Herb. S. & W.
Do. ...	9—12,500	R.	D.	...	
Do ..	10,000	R	...	...	
Forest ...	9,000	R.	...	...	
Do ...	9—10,500	R.	...	...	
...	...	...	...	...	
Do. ..	10—11,000	R	...	...	
Do. ...	4—10,500	R	D.	...	
Near water ...	4—6,000	R	...	...	
Woods ...	7,5—10,000	R.	...	...	
Open ...	12—15,000	R.	D.	T.	
Do. ...	11,5—14,000	R	D.	T.	
Do. ...	16,800	...	...	T.	
Open, wet ...	11—16.000	R.	D.	T.	
Wet ...	15,500	...	...	...	
Wet banks ...	3—7,000	...	...	...	
Wet rocks ...	8,000	R.	...	...	
Open ...	12,000	...	...	...	
Shady banks ...	4,500	...	...	...	
Open & woods,	9—12,000	R	...	...	
Woods, wet ...	8,000	R.	...	...	
Open ...	14—15,000	R.	...	...	
Do. ...	14—16,000	R	D.	T.	
Fields ...	1—3,000	R.	...	...	
Open ...	5—7,500	R.	...	...	
Do. ...	6—7,500	R	..	...	
Do. banks ...	8—12,000	R.	...	...	
Open ...	15—17,000	...	...	T.	
Banks ...	8,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
2. Androsace— (*concluded*).						
sp. —— ...	7	H	3″—4″	Pr	July ...	Bampa, Níti ...
villosa, *L.* ...	8, 11	H. st	1″—2″	Pr.	July ..	Milam, Rogila, Gugé.
globifera, *Duby.* ...	9	H.	1″	Pr.	July ...	Barjikáng Pass,
3 Lysimachia.						
debilis, *Wall.* ...	1	H. er	6″	Y.	June ...	Gágar ...
pyramidalis, *Wall.*,	2	H.	1½′	Pk	July ...	Binsar ...
sp —— ..	3	H.	4″—6″	Pk.	May ..	Mádhári Pass, Dwáli.
alternifolia, *Wall.*,	4	H	6″	Pk	July ...	Almora, &c ...
lobelioides, *Wall.*,	5	H.	1½′	Pk.	August ...	*Jágesar* ...
4. Anagnathis						
arvensis, *L.* ...	...	H.	6″	Bl.	February,	Outer hills ...
LXVI.—MYRSINACEÆ.						
1. Mæsa.						
argentea, *Wall.* ...	1	Sh	5′—6′	...	May ...	Binsar ...
indica, *A.DC.* ...	2	Sh	15′—20′	...	March ...	Kota, outer hills.
2. Myrsine						
bifaria, *Wall* ...	1	Sh	3′—4′	R.	February,	Binsar, &c &c,
semiserrata, *Wall*,	2	Sh.	20′	...	March .	Naini Tál, &c.,
3. Embelia.						
robusta, *Roxb.* ...	...	Sh	15′	...	...	Kota- Dún ...
4 Ardisia.						
floribunda, *Wall.* ...	...	Sh	10′	Pk.	May ...	Below Binsar,
humilis, *Vahl.* ...	...	Sh	8′	...	...	Ponágiri ...
LXVII.—SAPOTACEÆ.						
1 Bassia.						
butyracea, *Roxb.* ...	1	Tr	35′	...	January ...	Bhábar ...
sp.—— ...	2	Tr	25′	...	January ...	Sarju valley ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himálaya* Rainy	*Himálaya* Dry	Tibet	Remarks.
Rocks ..	11—12,000	...	D.	...	
Open ...	11—15,500	*R*	*D*	T	
Do ...	14,700	R.	...	...	
Wet, shade ...	6—7,000	R	...	...	
Woods ...	7,000	R.	...	. .	
Damp woods ...	9,000	R	...	..	
Open ...	5—6,500	R.	...	.	
Open, by water,	4—7,000	R	...	...	
Fields ...	1—5,000	R.	...	...	
Forest ..	5,000	R	...	...	
Do. ...	2—5,000	R.	...	...	
Woods ...	5—7,000	R	...	...	
Do ...	7,000	R.	...	...	
Forest ...	1,500	R.	...	...	
Do. ...	4,000	R.	...	...	
...	2—4,000	R	...	..	
Forest ...	1,000	R	...	...	
Do. ..	3,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower	Time of flowering.	Locality.
LXVIII.—EBENACEÆ						
1. **Diospyros**						
lanceæfolia, *Roxb.* ..	...	Tr.	30′	Wh.	...	Kota Dún ..
LXIX.—STYRACEÆ.						
1. **Symplocos**						
cratægoides, *Don* ...	1	Tr	15′—25′	Wh.	May ...	Binsar, Almora,
Hamiltoniana, *Wall*,	2	Tr.	20′	Wh.	March ...	Eastern Bhábar,
ramosissima, *Wall.*,	3	Tr.	20′	Wh.	May ..	Binsar, Gágar,
polystachya, *Wall*,	4	Tr.	35′	Wh.	September,	Maikhanda ...
LXX.—OLEACEÆ.						
1. **Jasminum.**						
revolutum, *Sims* ...	1	Sh	15′	Y.	May ...	Dwáli ..
var inodorum ...	2	Sh	10′	Y	April ...	Naini Tál ..
pubescens, *Willd.* ...	3	S. sc.	10′—15′	Wh.	March ...	Bhábar, Bágesar.
officinale, *L.* ...	4	S sc.	10′	Wh.	May ...	Naini Tál, Káthi.
grandiflorum, *L* ...	5	Sh.	8′—10′	Wh.	March ...	Almora, outer hills.
dispermum, *Wall.*...	6	S sc.	10′	Wh	April ..	Rámgar valley,
arborescens, *Roxb* ..	7	S. sc.	8′—10′	Wh	February,	Bhábar ...
glandulosum, *Wall.*,	8	Sh	10′	Wh.	May ...	Bhainskhet ...
2. **Nyctanthes.**						
arbor-tristis, *L.* ...	...	Sh	10′—20′	...	May ...	Kota Dún ...
3 **Schrebera.**						
swietenioides, *Roxb*,	...	Tr	20′—30′	Wh.	June ...	Do. ...
4. **Syringa.**						
Emodi, *Wall.* ...	...	Sh.	15′	Wh.	May ...	Dwáli, Níti, &c.
5. **Fraxinus.**						
floribunda, *Wall.* ...	1	Tr	40′	Gr.	April ...	Naini Tál, Binsar.
xanthoxyloides, *Wall*,	2	Tr	20′	...	May ...	Dhauli river ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himâlaya.* Rainy.	*Himâlaya.* Dry.	Tibet.	Remarks.
Forest ...	2,000	R.	...	...	
Do. ...	4—8,000	R.	...	...	
Do ...	1,000	R	...	...	
Do. ...	7—8,000	R	...	...	
Do. ..	5,500	R	...	...	
Do. ...	8,5—9,500	R	...	...	
Woods ..	6,5—7,500	R.	...	...	
Do. ...	1—3,000	R.	...	...	
Do. ...	7—8,000	R.	...	...	
Open ...	4—8,000	R	...	...	
Do. ...	4—7,000	R	...	...	
Do. ...	1—2,500	R	..	...	
Do. ...	2,5—3,500	R.	...	...	
Do. ...	2,5—3,500	R.	...	...	
Forest ...	1,500	R.	...	...	
Do. ...	8,5—11,500	R.	D.	...	
Do. ...	6,5—8,000	R.	...	...	
Open ...	9—10,000	...	D.	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant	Colour of flower.	Time of flowering.	Locality.
6 Olea.						
glandulifera, *Wall.*	1	Tr	30′	Wh.	April	Naini Tál, outer hills
acuminata, *Wall.*	2	Tr.	40′—50′	Wh.	June	Kapkot
cuspidata, *Wall.*	3	Sh	10′	...	June	Josimath
compacta, *Wall.*	4	Tr	30′	Wh.	May	Satiali valley,
7 Ligustrum.						
nepalense, *Wall.*	1	Sh.	15′	Wh.	June	Binsar
bracteolatum, *Don,*	2	Tr.	20′	Wh.	May	Kapkot
robustum, *Hf. & T.*	3	Tr.	15′	Wh	May	Tola (Sarju valley).
LXXI.—APOCYNACEÆ.						
1. Carissa.						
diffusa, *Roxb.*	...	Sh.	10′	W.	June	Outer hills
2. Vinca.						
pusilla, *Murr.*	...	H.	1′	Bl.	October	Háwalbágh
3. Alstonia.						
scholaris, *R. Br.*	...	Tr.	30′—40′	Wh	March	Kota Dún
4. Tabernæmontana.						
coronaria, *R. Br.*	...	Sh	6′	Wh.	July	Bágesar
5 Holarrhena.						
antidysenterica, *Wall.*	1	Tr.	25′	Wh.	January	Bhábar
pubescens, *Wall.*	2	Tr	20′	Wh.	January	Do.
6. Vallaris						
dichotoma, *Wall.*	...	S. sc.	15′—20′	Wh.	March	Do.
7. Wrightia						
mollissima, *Wall*	...	Tr.	30′	Wh.	January	Do.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya.* Rainy.	*Himá-laya.* Dry.	Tibet.	Remarks.
Open ...	3,500	R	...	...	
Forest ...	3,500	R	...	...	
Woods ...	6—8,000	R	..	...	
Do. ...	5—6,000	R.	...	...	
Forest ..	6—7,000	R.	...	..	
Do. ...	3,500	R.	...	...	
Open ..	6,500	R.	...	...	
Forest ...	1—3,500	R.	...	...	
Open ...	4,000	R.	...	...	
Forest ...	1—2,000	R.	...	...	
Cultivated ...	1—3,000	R.	...	...	
Forest ...	1,000	R.	...	...	
Do. ...	1,000	R.	...	...	
Open ...	1—3,000	R	...	...	
Forest ...	1—2,500	R.	...	..	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering	Locality.
8. Nerium.						
odorum, *Soland.* ...	...	Sh	6′	Pk.	May ...	Bágesar, &c. ...
9. Chonemorpha.						
macrophylla, *G Don,*	...	Tr.	...	...	...	...
LXXII.--ASCLEPIADACEÆ.						
1. Cryptolepis.						
reticulata, *Wall.* ...	...	S. sc.	10′	...	...	Bágesar, Bhábar.
2. Periploca.						
calophylla, *Falc.* ...	...	S sc.	40′	Gr. Br.	March ...	Outer hills ...
3. Calotropis.						
procera, *R Br.* ...	1	Sh.	8″—10″	Wh. Pr	March ...	Bhábar ...
gigantea, *R. Br.* ...	2	Sh.	...	...	March ...	Do. ...
4. Vincetoxicum.						
sp —— ...	...	H.	1′	...	July ...	Bampá, Bhatkot
5 Cynanchum.						
auriculatum, *W & A*	1	H. Sc	8′	Gr Y.	August ...	Rálam Valley,
glaucum, *Wall.* ...	2	H.	1′—1½′	Y.	August ..	Almora, Naini Tál.
Dalhousiæ, *W. & A*	3	H. Sc.	2′—3′	...	August ...	Damus, &c. ...
6. Pentasachme.						
Wallichii, *Wight* ...	...	Sh.	6″—12″	Wh.	May ...	Kapkot ...
7. Gongronema.						
nepalense, *Dcne* ...	...	H. Sc.	10′	Y.	August ...	Bágesar, Mohargári.
8. Tylophora.						
Govanii, *Dcne* ...	1	Sh.	12″	Pr.	June ...	Jagthána Pass
hirsuta, *Wight* ...	2	...	...	...	...	?

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Hima-laya*		Tibet	Remarks.
		Rainy.	Dry		
Near water ...	1—4,000	R	...	...	
...	...	R.	...	...	
Open ...	1—3,500	R.	...	...	
Forest ...	4,500	R.	...	...	
Open ...	1—1,500	R.	..	..	
Do. ...	1—1,500	R.	...	...	
Do. ...	9—10,500	R	D.	...	
Forest ...	8,500	R.	...	...	
Ditto ...	5-8,000	R.	...	...	
Open. ...	5—6,500	R.	...	...	
Shady, wet. ...	3,500	R.	...	...	=*Marsdenia* No. 5 in Herb S. & W.
Open ...	3—5,000	R.	...	...	
Ditto. ...	8,400	R.	...	...	
...	?	...	...	...	

Name.	*Herbarium number* (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower	Time of flowering.	Locality.
9 Marsdenia.						
tenacissima, *W. & A.*	1	H. Sc.	8'—10'	...	July	Almora.
Calesiana, *Wight*	2	S Sc		..	July	Ditto
Roylei, *Wight*	3	S Sc.	10'	Or	May	Sarju valley, Naini Tal
lucida, *Edgew.*	4	H. Sc	30	Pr.	August	Binsar, Naini Tal
sp.——	6	...	...	...	...	?
10. Pergularia.						
odoratissima, *L.*	...	H Sc.	15'	...	June	Almora, outer hills ...
11. Hoya						
lanceolata, *Wall.*	1	S. sc.	20'	Wh.	March	Kota Dún, Kapkot
longifolia, *Wall.*	2	S sc.	15'	...	...	Bágesar
12 Leptadenia						
viminea	...	Sh.	4'—6'	...	May	Bhábar
13 Ceropegia						
elegans, *Wall*	1	H. Sc.	10'	Pr.	July	Almora ...
Wallichii, *Wight*	2	H	1'	Pr	April	Naini Tál ...
LXXIII.—LOGANIACEÆ.						
1 Buddleia.						
crispa, *Benth.*	1	Sh	6'—10'	Li.	March	*Almora*
Neemda, *Ham.*	2	Sh	6'—10'	Wh.	April	Bhábar
2 Gardneria.						
angustifolia, *Wall.*	...	S sc.	15'	...	March	Binsar, Gágar,
LXXIV.—GENTIANACEÆ.						
1. Crawfurdia.						
fasciculata, *Wall*	...	H sc	7"—10"	Bl.	August	Mádhári Pass.

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himalaya.*		Tibet	Remarks.
		Rainy	Dry		
Open	4,500	R	...	...	
Ditto	4,500	R.	...	...	
Ditto	5—6,000	R.	..	...	
Woods	5—7,500	R.	...	...	
...	...	...	...	...	
Open.	2—4,000	R.	...	...	
Forest	3,500	R.	...	...	
On rocks	3—3,500	R.	...	...	
River beds	1—2,000	R	...	...	= *Orthanthera* in Herb. S. W.
Open	4,500	R	..	...	
Do.	6,500	R.	...	...	
Do	5—8,000	R	...	...	
Do.	1—1,500	...	D	...	
Forest	6,5—7,000	R.	...	...	
...	...	...	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
2. Gentiana						
aprica, *Dcne.* ...	1	H.	3″—4″	Bl.	March ...	Kota Dún ...
tubiflora, *Wall.* ...	2	H.	1″	Pi	August ...	Barjikáng Pass
venusta, *Wall.* ...	3	H	1″—1½″	Bl	August ..	Do ...
depressa, *Don* ...	4	H.	3″	Bl W.	August ...	Milam ...
capitata, *Ham.* ...	5	H.	4″	Bl	March ...	Shandevi ..
decemfida, *Ham.* ...	6	H.	4″	Bl	May ..	Dwáli ...
marginata, *Griseb.*,	7	H.	2″	Bl.	March ..	Almora, Naini Tál.
sp —— ...	8	H.	1″	Bl	May ..	Champwa .
pedicella, *Wall.* ...	9	H.	3″—6″	Bl	May ...	Námik, Naini Tál.
sp —— ...	10	H.	2″—6″	Bl.	May ...	Almora, Naini Tál.
sp —— ...	11	H.	½″	Bl	June ...	Sagtea, Deo Pass.
argentea, *Royle* ...	12	H.	1″	Bl.	June ...	Do. ...
Moorcroftiana, *Wall*,	13	H.	3″—4″	Bl.	September,	Rajhoti, Pindari.
sp.—— ...	14	H	4″	Bl.	September,	Valleys of Gugé.
aquatica, *L.* ...	15	H	1″—2″	Bl.	September,	Gating, Gyanima
tenella, *Fries* ...	16	H.	3″	Bl.	September,	Sángchá, &c. ...
nubigena, *Edgew* ...	17	H.	6″	Bl	September,	Rákas Tál, Balchha Pass
sp —— ...	18	H.	¾″	Bl	September,	Bajikáng Pass,
squarrosa, *Ledeb.* ..	19	H.	½″	Bl.	September,	Topidhunga ...
sp —— ...	20	H.	6″—8″	Wh	September,	Milam, Lanjar,
sp —— ...	21	H.	1′—1½′	Wh.	August ..	Rálam ...
decumbens, *L.* ...	22	H.	6″	Bl.	August ..	Rajhoti ...
3. Pleurogyne.						
corinthiaca, *Griseb.*	2	H.	4″	Bl.	August ...	Milam, Rajhoti,
var —— ...	1	—	...	...	...	...
4. Ophelia						
cordata, *Don* ...	1, 8	H.	1′—3′	...	August ..	Naini Tál, Binsar, Kálimundi, and Mádhári Passes
floribunda, *Don* ...	2	H	3′	Gr. Y.	August .	Naini Tál ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya*		Tibet.	Remarks.
		Rainy.	Dry.		
Shady banks ...	2,000	R	...	...	
Open ...	14,000	R	...	..	
Do ..	14,000	R	..	..	
Do. ...	12,000	...	D.	..	
Do. ...	6,000	R	...	...	
Do. ...	8,2,000	R	...	...	
Do. ...	5—7,000	R	..	...	
Do. ..	12,000	R.	..	...	
Open ..	7—8,500	R	...	...	
Do. ..	5—8,000	R.	...	..	
Do. ...	11,500	R	..	..	
Do ...	11,500	R.	.	..	
Do. ...	12—15,000	R	D.	T	
Do. ...	15,000	...	...	T.	
Wet open ..	13,5—1500	...	D.	T	
Open ...	15,000	...	D.	T	
Do. ...	15—17,000	...	..	T.	
Do. ..	14,500	R	...		
Do. ...	15,000	...	...	T.	
Do ...	13—17,000	.	D.	T.	
Do. ...	12,000	R	...	..	
Do. ...	15,000	...	..	T	
Do. ...	12—15000	...	D.	T.	= *Swertia* No. 1 in Herb S and W.
...	...	...	...	...	
Do. ...	0—10,000	R.	...	...	
Do. ...	7—8,000	R	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
4. Ophelia—(*concluded*)						
alata, *Griseb.* ...	3, 5	H.	2′—3′	...	August ...	Binsar, Almora
purpurascens, *Don*,	4	H.	2′—3′	...	August ...	Do. Naini Tál,
angustifolia, *Don* ...	6	H.	1′—2′	...	August ..	Almora, Sarju valley.
paniculata, *Don* ...	7	H.	2′	..	August ..	Binsar, Gágar,
pulchella, *Don* ...	9	H.	...	...	...	Almora ..
Dalhousiana, *Griseb.*,	10	H.	1′—2′	...	August .	Rálam ...
5. Swertia.						
speciosa, *Wall.* ...	2	H	3′—4′	W. Bl	August .	Pindari, Rálam
cœrulea, *Royle* ...	3	H.	9″—12″	Bl.	August ..	Rálam ...
6 Halenia.						
elliptica, *Don* ...	...	H.	2′	Li.	August ...	Tola, Kálamundi.
LXXV.—POLEMONIACEÆ.						
1. Polemonium						
cœruleum, *L.* ..	...	H.	3′	Bl.	August ...	Tola, Milam ...
LXXVI.—BORAGINEÆ.						
1. Cordia.						
Myxa, *L.* ...	1	Tr.	40′	...	...	In Bhábar ...
latifolia, *Roxb.* ...	2	Tr	...	...	March ...	Ditto.
2 Ehretia.						
serrata, *Roxb.* ..	1	Tr	40′	W	May ...	Outer hills ..
lævis, *Roxb.* ..	2	Tr.	30′	W	March ...	Bhábar ...
3 Rhabdia.						
viminea, *Dalz* ..	...	Sh	6′	Wh	March ...	Sarju valley ...
4 Heliotropium						
brevifolium, *Wall* ..	...	H.	8″	Pk.	July ...	Almora ..

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	*Remarks.*
		Rainy	Dry		
Open ...	1—7,000	R	...	...	
Do. ..	6—10,000	R	...	...	
Do	3—6,000	R.	...	...	
Do ...	6—7,500	R	...	..	
Do. ...	...	R	...	...	
Do ...	12,000	R	...	...	
Wet open ...	10—12,000	R	...	...	
Open ...	12,500	R.	...	...	
Do. ...	7, 5—11,500	R.	...	...	
Do. ...	11—12,000	R.	D.	...	
Forest ...	1—3,000	R.	...	...	
Do. ...	1,000	R	...	...	
Open ...	3—5,500	R.	...	...	
Forest ...	1—2,500	R.	...	...	
River bed ...	2,500	R.	...	...	=*Ehretia* No. 3 in herb. S. & W.
Open ...	5,500	R.	..	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality
5 Trichodesma.						
indicum, *R Br.* . .	...	H.	6″—12″	Pr.	March ...	Outer hills ...
6. Cynoglossum.						
microglochin, *Benth*	1	H.	3′ - 4′	Bl.	August ..	Rálam valley ..
sp —— ...	2	H.	3′—4′	Bl.	August ...	Gori valley ..
furcatum, *Wall* ...	3	H	3½′	Bl	June ...	Bínsar, Gágar...
sp —— ...	4	H	3′	Bl.	August .	Milam ...
Wallichii, *Don* ...	5	H	2′	Bl.	August ..	Rálam valley .
furcatum, *Wall* ...	6	H	2′—3′	Bl.	March ...	Samkhet ...
sp —— ...	7	H	2′	Bl.	June ...	Dhauli valley, ..
micranthum, *Desf.*,	8	H	2′—3′	Bl.	June ...	Almora ...
sp.—— ...	9	H	...	. .	August ...	Kálamundi ...
sp —— ...	10	H	...	...	...	...
sp.—— ...	11	H.	...	...	...	Dadatoli ...
grandiflorum, *Benth.*	12	H	9″	Bl.	June ..	Patharkori ...
7. Solenanthus.						
sp —— ...	1	H.	1′	Bl.	August ...	Laptel ...
sp.—— ...	2	H	2′	Bl.	July ...	Do Rajpot ..
8. Echinospermum.						
barbatum, *Lehm.* ...	4	H.	9″—12″	Bl.	July ...	Dhauli valley,
glochidiatum, *DC.*	5	H	2′	Bl.	May ...	Dwáli, Pindari,
sp.—— ...	6	H.	3″	Bl.	May . .	Do. ...
9. Eritrichium						
sp.— ...	1	H.	2″	Bl.	August ...	Kyungar Pass
rotundifolium, *DC.*	2	H.	3″	Bl.	June ...	Patharkori ..
nemorosum *DC.* ..	3	H.	6″	Wh.	May ...	Dwáli ...
longifolium, *Don* ...	4	H.	3″	..	August ..	Gugé, Milam...
sp.—— ...	5	H.	2″	Wh.	August ..	Rálam ...
sp.—— ...	6	H	2″	Wh.	August ...	Do. ...
10. Asperugo.						
sp.—— ...	...	H.	2″	Bl.	August ...	Kyungar Pass,
11. Bothriospermum.						
tenellum, *Fisch and Mey* ...	...	H.	9″	Bl.	February,	Kapkot . .

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	1—5,500	...	...	...	
Do. .	8,000	R	...	...	
Do ...	6—8,500	R.	...	...	
Woods ..	5—7,500	R.	...	...	
Open ...	11,500	..	D.	...	
Do. ...	8,500	R.	...	...	
Do. ...	5,500	R.	..	..	
Do. ...	8—11,000	R.	D.	...	
Do. ...	5,000	R.	...	...	
Woods ...	8,500	R	...	...	
...	...	...	..	...	
Woods ...	8,000	R.	...	...	
Open ...	11,000	R.	...	...	=*Lithospermum* No. 1 in Herb. S. & W.
Do, ...	15,000	...	...	...	
Do. ...	14—15,000	...	...	...	
Do. ...	7—12,000	R	D.	...	
Do. ...	8—12,500	R.	...	...	
Do. ...	8—12,500	R.	...	...	
Do ...	16,000	.	...	T.	=*Myosotis* No. 1 in Herb. S. & W.
Do. ...	11,000	R.	...	...	
Woods ...	8,600	R	..	...	=*Myosotis* No. 4 in Herb S. & W.
Open ...	15—15,000		D.	T.	=*Echinospermum* No. 3 in Herb. S. & W.
Do. ...	12,000	R	...	...	
Do. ...	12,000	R.	...	...	
Do. ...	16,500	R.	...	T.	
Fields ...	3,500	...	...	...	

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth	Height of plant.	Colour of flower	Time of flowering.	Locality.
12 Myosotis						
pallens, *Wall.* ...	1	H	6″—8″	Bl.	August ...	Rálam, Tola ..
sylvatica, *Hoffm* ...	2	H	1′	Bl	June ..	Pindari ...
13 Lithospermum.						
tenuiflorum, *L.* ...	2	H	...	...	...	...
14. Macrotomia						
Benthami, *DC.* ...	1	H	2½′	Bl	July ..	Rálam, &c. ...
bracteata, *DC* ...	2	H.	1′—1½′	Bl.	July ..	Pindari, Rajhoti.
15 Onosma.						
echioides, *Benth.* ..	2	H.	...	...	..	
Emodi, *Wall.* ...	...	H	2′	Bl. Pr	September,	Tungnáth ..
LXXVII.—CONVOLVULACEÆ.						
1 Ipomæa.						
sessiliflora, *Roth* ..	1	H. Sc	4′—5′	Pr.	August ...	Almora ...
pes-tigridis, *L.* ...	2	H Sc	6′	Pk.	August ...	Do &c. ..
sp. (oxyphylla, *Edgew.* ...	3	H Sc.	12′	.	August ...	Naini Tál ...
bona-nox, *L.* .	..	H. Sc.	12′	Pr	August ...	Rámganga valley, &c
2 Convovulus						
arvensis, *L* ..	..	H Sc	2′—3′	Pk.	August ...	Níti ...
Nil, *L*	.	H Sc	3′—4′	Li	August ...	Gangoli, &c. ..
barlerioides, *Ham.*	..	H.	4′	Pk.	August ...	Almora ...
3 Evolvulus						
hirsutus *Ham.* .	...	H cr.	2″—3″	Bl.	All the year.	Almora, &c ...
4 Porana						
paniculata, *Roxb*	1	H. Sc	20′	W.	March ...	Outer hills ..
racemosa, *Roxb.*	2	H Sc	15′	W.	September,	Almora ...
5. Cuscuta.						
macrantha, *Don* ...	1	H Sc	6′	W Pk	October .	Outer hills ...
reflexa, *Roxb*	2	H Sc	6′	W	October ..	Do. ..
capillaris, *Edgew.*	3	H. Sc	6″	Pk	August ..	Rálam, Níti ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himálaya.* Rainy.	*Himálaya.* Dry	Tibet.	Remarks.
Open	12,000	R	D	..	
Near water	11,000	R.	...	...	
...	...	R.	...	...	
Open	11—12,000	R	...	...	
Do.	12—15,000	R	D	T	
...			...	..	
Open	12,000	R	..	...	=*Maharanga* in Herb. S. & W.
Do	15,000	R	...	.	
Do	14,000	R	..	...	
Woods	6,000	R.	.	..	
Open	3—5,000	R	..	. .	=*Calonyction speciosum* in Herb. S. & W.
Fields	11,500	R	D.	.	
Open	5,000	R.	..	..	=*Pharbitis Nil* in Herb. S. & W.
Do.	4,000	R.	...	..	=*Aniseia* in Herb. S. & W.
Do.	1—5,000	R.	..	...	
On bushes	1—4,500	R	...		
Do.	4,500	R		.	
Do	1—5,500	R	. .	..	
Do	1—5,000	R		..	
On herbs	11—12,000	R	D	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Habit of plant.	Colour of flower	Time of flowering.	Locality.
LXXVIII.—SOLANACEÆ						
1 Solanum						
nigrum, *L* ...	1	H.	1′	Wh.	March ..	Outer hills ...
xanthocarpum, *Schrad.*, var Jacquinii ..	2	H.	9″	Pr.	All the year.	Do ...
lysimachioides, *Wall*,	3	H.	9″	Pr.	August ...	Gori valley ...
verbascifolium, *L*....	4	Sh.	12′—15′	Wh.	February,	Bhábar, Bágesar
indicum, *Nees* ...	5	Sh.	3′	...	...	Bhim Tál ..
sp —— ...	6	Sh.	4′	...	...	Alaknanda valley.
sanctum, *L*. ...	7	H	...	...	...	Bhábar ...
sp.—— ...	8	H.	1′	...	...	Outer hills ..
2. Physalis.						
flexuosa, *L*. ...	1	H.	2′—3′	...	February,	Káladhúngi ...
peruviana, *L*. ...	2	H.	6″	Wh.	July ..	Almora ...
3 Datura.						
Stramonium, *L*. ...	1	H.	3′	Wh.	July ...	Almora, Naini Tál.
sp.—— ...	2	H.	4′	Wh.	July ...	Do. ...
4. Scopolia						
præalta, *Dcne*. ...	...	H	1′—1½′	Gr. Y.	July ...	Níti, Tisum ...
5. Hyosciamus						
niger, *L* ...	...	H	3′	Pr.	July ...	Malári, &c. ...
6 Nicotiana.						
sp.—— ...	...	H.	...	...	...	Almora ..
LXXIX.—SCROPHULARIACEÆ.						
1 Verbascum						
Thapsus, *L*. ...	1	H.	3′	Y.	August ...	Rálam, Milam
var.—— ...	2	H.	3′—5′	Y.	June ...	Naini Tál, ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himalaya*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	1—7,000	R.	...	...	
Do ...	1—5,000	R	...	...	
Do. ...	4—,5000	R.	..	...	
Do. ...	1—3,500	R	...	...	
Do. ...	5,000	R.	...	...	
Banks ..	4,500	R	...	...	
Open ...	1,000	R	...	...	
Do ...	4,000	R.	...	...	
Do. ...	1,000	R	...	...	
Do. ...	5,500	R.	...	...	
Do. ...	5—7,500	R	...	...	
Do. ...	5,000	R.	...	-	
Do. ...	11,5—15,000	...	D.	T.	
Do. ...	10—11,000	...	D.	...	
Cultivated ...	1—5,000	R	...	...	
Open ..	12,000	R.	D.	...	
Do ...	5—8,000	R.	...	...	

Name	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering	Locality
2 Celsia						
coromandeliana, *Vahl.*	...	H	2′—3′	Y.	May ...	Bágesar ...
3 Linaria						
ramosissima, *Wall.*	.	H.	6″—9″	Y.	All the year.	Almora, &c. ...
4 Antirrhinum						
Orontium, *L.* ..	...	H.	1′—2′	Pk Y.	March ...	Do. ...
5 Scrophularia						
decomposita, *Royle* .	1	H	2′	...	July ...	Milam ...
variegata, *Rich* ..	2	H.	2′—3′	...	June ...	Malári, &c. ...
obtusa, *Edgew.*	3	H	2′	...	Do ...	Almora ..
himalaiensis, *Royle*	4	H.	4′—5′	..	July ..	Nainí Tál ...
Edgeworthii, *Benth*	5	H.	3′	Pr. Gr.	August ...	Sálm .
calycina, *Benth.* .	6	H.	1′	.	June ..	Pindari, Patharkori.
sp.—— ..	7	H.	1′—1½′	...	July ..	Laptel ...
6 Mimulus.						
gracilis, *R.Br.* ..	...	H.	1½′	..	April ...	Lodh ...
7 Mazus.						
dentatus, *Wall* .	1	H.	6″—9″	Pk.	August ...	Betuli Pass ...
rugosus, *Lour* .	2	H.	6″	Pr.	March ..	Almora ...
surculosus, *Don* .	3	H.	6″	Pr	Do. ...	Kapkot ...
8. Lindenbergia						
urticæfolia, *Lehm.* .	1	H	6″	Y.	August ...	Jagesar, &c. ...
grandiflora, *Benth*	2	H	1′	Y.	January ...	Bágesar, &c ...
macrostachya, *Benth*,	3	H	2′—3′	Y.	March ...	Kálapathar ...
9 Limnophila						
menthastrum, *Benth*,	1	H	6″	...	July ...	Almora ...
Roxburghii, *G Don*,	2	H.	4″	...	February ...	Pátli Dún ...
hypericifolia, *Benth*,	3	...	+	.	...	...
10. Herpestis						
Monnieria, *H B K.* ...	...	H.	6″	Li.	August ...	Bhábar, Rámganga valley.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya.*		Tibet.	Remarks.
		Rainy	Dry.		
Open ...	1—3,000	R.	...	...	
Banks ..	1—5,500	R	...	.	
Fields ...	1—5,000	R.	...	..	
Open ...	13,000	..	D.	...	
Do. ...	10,500	...	D	...	
Do. ...	5—7,000	R.	.	...	
Woods ..	6—7,000	R.	..		
Open ...	8,500	R.	..		
Do. ...	10—12,000	R	...	.	
Do ...	15,000	...	...	T.	
Do. ...	5,000	R.	...	...	
Wet rocks ...	8,000	R.	...	...	
Open ...	1—5,000	R.	...	..	
Do. ...	3—9,500	R.	...	..	
Shady banks ...	1—7,000	R.	..	..	
Do. ...	3—5,000	R.	...	...	
Open ...	1—2,000	R.	...	...	
Wet ...	4,000	R.	...	...	
Do. ...	...	.	...	...	
...	...	...	...	...	
Do. ...	1—5,000	R.	...	...	

Name	Herbarium number (Strachey and Winterbottom.)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
11 Dopatrium						
junceum, *Ham.* ...	...	H.	9″	...	...	...
12 Torenia						
edentula, *Griff.* ...	...	H.	1″– 2′	Pr	September,	Naini Tál, Sarju valley.
13 Vandellia						
crustacea, *Benth* ...	1	H.	2″	Pk.	July ..	Almora ...
pedunculata, *Benth.*...	2	H.	12″	Bl.	July ...	Do ...
nummularifolia, *Don,*	3	H.	3″—4″	Pk,	August ...	Naini Tál ...
14. Bonnaya.						
brachiata, *Link.* ...	...	H.	3″	Pk.	July ...	Almora, &c. ...
15 Hemiphragma.						
heterophyllum, *Wall.,*	...	H. cr.	6″	...	May ...	Chína, Dhákuri Pass.
16. Picrorhiza.						
Kurrua, *Royle.* ...	1	H.	6″	Br. Pr.	Do. ...	Mádhári Pass...
sp —— .	2	H.	9″	...	July ...	Milám ...
17. Wulfenia.						
Amherstiana, *Benth.*...	...	H.	8″	Bl.	June ...	Binsar ...
18 Veronica.						
Anagallis, *L.* ..	1	H.	1′—2′	Pk.	March ...	Rámgar, &c. ...
laxa, *Benth.* ...	2	H.	6″—9″	Bl.	May ..	Dwáli .
ciliata, *Fisch.* ..	3	H.	3″—4″	Bl.	August ..	Barjikáng Pass,
sp —— ..	4	H.	6″	Bl.	September,	Milam, Topidhunga.
serpyllifolia, *L.* ...	5	H.	2″—6″	Bl.	August ...	Rálam ...
cana, *Wall* ..	6	H.	6″	Bl.	Do. ...	Sába ...
agrestis, *L.* ..	7	H.	6″—9″	Pk.	March ...	Almora .
Maddeni, *Edgew.* ..	8	H.	4″	Bl.	Do. ...	Do, Naini Tál
biloba, *L* ...	9	H.	6″	Bl.	March ...	Naini Tál, Milam.
capitata, *Royle* ..	10	H.	3″—4″	Bl.	August ..	Barjikáng Pass
lanosa, *Benth* .	11	H.	1′	Bl.	July .	Níti ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himá-laya*		Tibet.	Remarks.
		Rainy.	Dry.		
...	. .	R	. .	.	
Wet	4—7,000	R	...	...	
Do	4,000	R	.	. .	
Do	4,000	R	.		
Shady damp	5—6,000	R.	.	.	
Open	5,500	R	..	.	
Do.	7,5—11,000	R	...	..	
Do.	10—12,000	R.	.	.	
Do.	12,000	R.	D.	..	
Woods	7—10,000	R,	..	...	
Wet	5—6,500	R	...		
Open	8,500	R	. .	.	
Do.	13,500	R	...		
Do.	13—15,000	...	D.	T.	
Do.	12,000	R	.	...	
Woods	9—10,500	R.	. .	...	
Walls	5,000	R		...	
Open	5—7,500	R.	.	. .	
Do.	5—13,000	R.	D	...	
Do.	13,500	R.		. .	
Do.	10—13,000	..	D.	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower.	Time of flowering.	Locality.
19.—Buchnera.						
hispida, *Ham* ...	1	H.	1′	Bl.	October ...	Gopesar, Almora
sp.—— ..	2	H.	1′	Bl	Do ...	Almora, &c. ...
20.—Striga						
euphrasioides, *Benth*,	1	H.	6″	W	August ..	Tejam, &c, .
hirsuta, *Benth.* ..	2	H.	6″	Y.	Do ...	Gangoli, &c. ...
21.—Centranthera.						
hispida, *R Br.* ...	..	H	6″	Pr.	July ..	Almora ...
22.—Sopubia						
trifida, *Ham* ..	...	H	2′	Y.	August ..	Do. ...
23.—Leptorhabdos						
parviflora, *Benth.* .	...	H.	2′—3′	...	Do. ..	Gágar, Binsar,
24.—Euphrasia.						
officinalis, *L.* ...	...	H	3″—9″	Y. W.	June ..	Dhákuri-bináya, &c.
25.—Pedicularis						
megalantha, *Don* ..	1	H	1′—2′	Pr.	August ..	Kálimundi, Milam.
Ditto ..	7	H	6″	R.	Do. ...	Rálam ..
gracilis, *Wall.* ..	2	H.	1′—2′	Pr.	Do. .	Girgaon, Pitti river
Ditto .	11	A	9″	R.	Do. ...	Gothing ...
carnosa, *Wall.* ..	3	H.	6″—12″	R.	August .	Naini Tál, Almora.
siphonantha, *Don* ..	4	H.	6″	R	Do. ...	Rálam ...
pectinata, *Wall.* .	5, 15	H	3′	R	Do .	Sába .
tubiflora, *Fisch.* .	6	H.	4″	Y.	Do. ...	Milam, valleys of Gugé
verticellata, *Wall.* ...	8	H	4″—6″	R.	Do. ..	Barjikáng Pass
versicolor, *Wall.* ...	9	H.	6″	R	May ..	Pindari ..
Ditto ..	13	H.	4″—9″	Br Y.	September.	Rimkin, Balchha Pass.
Hookeriana, *Wall.* ...	10	H.	4″—6″	R.	June ...	Rogi-la ...
rhinanthoides, *Schrenk.* ..	12, 13	H.	6″	R.	September,	Balchha Pass ..
sp.—— ...	14	H	3″	R.	Do ...	Do. ..

Plants (continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himalaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	3—5,000	R.	...	..	
Do ...	4,000	R.	...	...	
Do ...	4,000	R	...	...	
Do. ..	4—5,000	R	...	...	
Wet .	3—4,000	R	..	.	
Open ...	5—6,500	R	..	..	
Do. ...	6—8,000	R	...	...	
Do. ..	8—12,000	R	D.	...	
Do ..	7—11,500	R.	D	...	
Do. ...	12,000	R	..	..	
...	...	.	...	.	
Do .	12,500	...	D.	.	
Do ...	5—7,000	R	..	..	
Do ...	12,000	R	...	..	
Do. .	8—9,000	R.	.	..	
Do. ..	11—15,000	...	D	T.	
Do. ...	14,700	R.	...	..	
Do ...	10,500	R	..	..	
Do. ...	13—16,500	.	...	T.	
Do. ...	11,000	R	...	...	
Do. ...	13—16,500	...	.	T.	
Do. ...	16,500	.	.	T.	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant	Colour of flower	Time of flowering	Locality.
LXXX.—OROBANCHACEÆ.						
1.—Æginetia						
indica, *Royle.* ...	.	H.	1′	Br. Pr	August ...	Kapkot, Bhimtal.
2.—Orobanche						
indica, *Wall.* ...	1	...	9″—12″	..	March ...	Hardwár ..
sp — ..	2	...	6″—9″	...	May ..	Dwáli, Ramni,
sp — ..	3		2′	...	July ..	Tola .
epithymum, *DC.* ...	4	...	6″—8″	...	July ..	Rálam, Milam,
LXXXI.—PLUMBAGINACEÆ						
1.—Plumbago.						
zeylanica, L ...	..	Sh	4″—5″	Pk.	March ..	Bhábar, Bágesar.
LXXXII.—GESNERACEÆ						
1.—Æschynanthus						
ramosissima, *Wall* ...	...	H. sc	1′—1½′	Sc.	August ...	Mohargári ...
2.—Lysionotus.						
ternifolia, *Wall.* ..	...	H.	9′—15′	Pr.	Do ..	Bágesar ...
3.—Rhynchoglossum						
obliquum, *DC.* ..	...	H.	1′—1½′	Pr Bl.	October ..	Outer hills ...
4.—Platystemma						
violoides, *Wall* ..	...	H.	3″	Bl.	August ...	Naini Tál ...
5.—Didymocarpus.						
lanuginosa, *Wall.* ...	1	H	3″	Pr.	Do ...	Almora ..
macrophylla, *Wall* .	2	H.	9″	Pr.	Do ...	Mohargári, Bágesar
subalternans, *Wall* ..	.	H.	1′	Pr.	Do. ...	Dyári Pass, Ramni.
6.—Chirita						
bifolia, *Don* ...	1	H	4″	Pr Y	Do ...	Outer hills ..
Edgeworthii, *DC.* ...	2	H	6″	Pr.	Do ...	Gangoli, &c. .

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himalaya.*		Tibet.	Remarks.
		Rainy	Dry		
Open ...	3—4,000	R.	...	...	
Fields ..	1,000	R	...	..	
On trees .	8—10,000	R		...	
Fields ..	11,500		D	...	
On Thymus .	12—13,000	R	D	...	
Woods ...	1—3,000	R		..	
Trees ...	4,000	R.	..	...	
Trees & banks,	2,5—4,000	R.		...	
Shady banks ..	1,5—4,500	R.	...	...	
Trees & rocks.	6—8,500	R.	...	...	
Dry rocks ..	5,000	R.	...	...	
Wet rocks .	3—5,500	R.	..	.	
Do. ...	6,5—8,500	R.	...	..	
Shady banks ...	2—5,000	R.	...	..	
Do. ...	4—5,000	R.	...	...	

Name.	Herbarium number (*Strachey and Winterbottom*)	Habit of growth	Height of plant.	Colour of flower.	Time of flowering.	Locality.
LXXXIII.—BIGNONIACEÆ.						
1 —Calosanthes						
Indica, *Bl.* .	...	Tr	...	..	...	Bhábar and outer hills.
2 -Stereospermum.						
suaveolens, *DC* ...	...	Tr.	...	...	...	Bhábar ...
3 —Amphicome						
Emodi, (*Royl*) ...	1	H.	6″	Pr.	March ..	Deoprayág ...
arguta, (*Royle*) .	2	S. H.	1′—1½′	Pr	July ...	Dhauli valley,
LXXXIV -PEDALINEÆ.						
1 —Sesamum.						
indicum, *L* ...	...	H.	3′—4′	...	Do. .	Bhábar, Almora.
LXXXV.—ACANTHACEÆ						
1 —Thunbergia.						
coccinea, *Wall* ...	...	Sh.	10′—15′	Sc	December,	Baliya bridge, Harara,
2 —Hygrophila.						
polysperma, *T. Anders.*	...	H.	...	..	...	Mohan ...
3.—Ruellia.						
hirta, *Vahl.* .	...	Sh.	2′	Bl.	March ...	Outer hills ...
4 —Petalidium						
barlerioides, *Nees* ...	...	Sh.	5′	Wh.	February,	Bhábar ...
5.—Strobilanthes.						
Edgeworthianus, *Nees*,	1	Sh.	3′	Bl.	December,	Kota Dún ...
auriculatus, *Nees* .	2	Sh	3′	Bl.	Do ...	Do. ..
glutinosus, *Nees* ..	3	Sh	2′—3′	Li.	February,	Kapkot ...
Wallichii, *Nees* ...	4	H.	2′	Bl.	August ..	Búr Pass ...
alatus, *Nees* ...	5	H.	3′	Bl	Do. ...	Diyari Pass ...
attenuatus, *Jacq* ..	6	H.	3′	Pr.	Do. ..	Loháthat ...
sp.—— .	7	H.	2′	Pr.	Do. ..	Tunghási ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himalaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Forest .	1—3,000	...	...	...	
Do, ...	1.. 3,000	...	...	...	
Open ...	1,500	R.	...	...	
On rocks ...	7,000	R	...	. .	
Open and cultivated	1—5,500	R.	...	..	
Forest ...	2,500	R.	...	...	=*Hexacentris* in Herb S & W.
...	2,000	R.	...	...	=*Hemiadelphis* in Herb. S. & W.
Shady woods ...	1—5,000	R.	...	...	
Forest ...	1,500	R	..	...	
Do. ...	2 000	R	...	.	
Do ..	2,000	R,	...	.	
Woods ...	3—5,000	R.	...	..	
Open ...	11,000	R	...	...	
Woods ..	6—7,000	R.	...	...	
Open ...	6,000	R.	...	. .	
Woods ...	9,000	R	..	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower	Time of flowering.	Locality.
6.—Goldfussia.						
capitata, *Nees* ...	1	H.	3′	Bl	August ...	Káhmandi ...
bracteata, *Nees* ..	2	H.	3′	Pr.	August ...	Mohargári ..
penstemonoides, *Nees*,	3	H.	3′	Li	August ...	Naini Tál ...
divaricata, *Nees* ..	4	H	3′	...	August ..	?
7.—Æchmanthera.						
Wallichii, *Nees* ..	...	Sh.	8′—10′	Bl.	August ...	Sarju valley ...
8.—Barleria.						
dichotoma, *Roxb* .	1	H	2′	Pr	August ..	Gangoli ...
cristata, *L* ...	2	H	3′	Pr.	September,	Bágesar ...
var —— ..	4	H	2′	Pr	September,	Kálápathar ..
cilialata, *Roxb.* ..	3	H.	2′	Pr.	September,	Outer hills ...
nepalensis, *Nees* ...	5	H.	3′	Wh	September,	Satiáli ...
9.—Asystasia.						
macrocarpa, *Nees* ...	...	H.	3′—4′	Pr.	October ...	Kota Dún ...
10.—Eranthemum.						
nervosum, *R.Br.* ..	..	Sh	3′	Bl.	March ...	Outer hills ...
11.—Phlogacanthus						
thyrsiflorus, *Nees* ...	...	Sh,	3′—4′	Or Br.	March ...	Kota Dún ...
12.—Lepidagathis.						
cuspidata, *Nees* ...	1	Sh	1′—2′	Wh. Pr	March ...	Outer hills ...
ustulata, *Nees* ...	2	Sh	1′—2′	Wh	March ...	Do. ...
purpuricaulis, *Nees* ..	3	Sh	1′—2′	Wh	March ...	Do. ...
hyalina, *Nees* ...	4	H.	1′	Wh.	March ...	Do. ...
13.—Justicia.						
micrantha, *Wall* ...	...	H.	9″	Li.	August ...	Rámari ...
procumbens, *L.* ...	...	H.	6″—9″	Pk.	March ..	Outer hills ...
Adhatoda, *L.* ...	...	Sh	8′—10′	Wh.	March ...	Plains, Bágesar,
14.—Rungia.						
parviflora, *Nees* ...	...	H.	3″—4″	Bl.	March ...	Sirmoria ...

Plants—(continued).

Conditions of soil, &c.,	Elevation in feet above the sea	*Himalaya*		Tibet.	Remarks.
		Rainy	Dry.		
Woods ...	8,500	R.	.	..	
Do ..	6,500	R	..	...	
Do. .	7,000	R	.	.	
Do.		...		...	
Open	4,000	R	.	.	
Do. ..	3—5,000	R	.	..	
Do. .	3,000	R	...	...	
Do. ..	2—6,000	R	.	..	
Do. .	9, 5,000	R	...	...	
Do. ..	*4,000*	R	...	...	
Shady banks	2,000	R.	..	...	
Woods ...	1—4,000	R.	..	...	
Forest ...	1,5—3,000	R	.	...	
Open .	2—5,000	R	...	..	
Do. ...	2—4,000	R	..	...	
Do .	2—4,000	R	..	...	
Do.	2—4,000	R	...	..	
Shady banks .	4,500	R	..	...	= *Rostellaria* No 2 in Herb S & W.
Open ...	3—5,000	R.	...	...	= *Rostellaria* No 2 ditto ditto.
Do. ...	4—5,000	R	...	...	= *Adhatoda vasica* ditto ditto.
Do. ...	4,000	R	..	...	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality
15 Dicliptera.						
bupleuroides, *Nees* ...	...	H.	2′	Pk.	...	Outer hills ...
16 Peristrophe						
speciosa, *Nees* ..	2	H. Sh	3′—4′	Pk	February,	Outer hills, Bágesar
sp —— ...	1	H. Sh	2′	Sc	August ..	Gangoli ...
LXXXVI.—SELAGINACEÆ						
1 Gymnandra						
kunawarensis, *Royle*	...	H	6″—9″	Bl	July ..	Ráj-hoti, Rákas Tál.
LXXXVII.—VERBENACEÆ						
1. Phryma.						
leptostachya, *L.* ..	...	H.	2′	Pk	August ..	Naini Tál, &c.,
2. Lantana.						
alba, *Mill* ..	...	Sh	4′	Wh.	March ...	Outtr hills ..
3. Lippia.						
nodiflora, *Rich.* ..	...	H. cr.	1′	Pi. Br	March ..	Kálápathar, &c.
4 Verbena.						
officinalis, *L* ..	...	H.	2′	Li.	March ..	Outer hills ..
5 Caliicarpa						
macrophylla, *Vahl.* ..	1	Sh.	10′	Li.	August ...	Outer hills, Bágesar,
arborea, *Roxb.* ...	2	Tr.	20′—30	...	May ...	Do. do. ...
6. Premna.						
herbacea, *Roxb.* ...	1	H.	2″—3″	W. Y.	May ..	Bágesar ...
interrupta, *Wall.* ...	2	Sh.	20′—30′	Wh	May ...	Supi ...
barbata, *Wall* ...	3	Tr.	25′	Wh.	May ..	Bhábar, Bágesar
integrifolia, *L.* ..	4	...	.	Wh	...	Do. ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	Himálaya		Tibet	Remarks.
		Rainy.	Dry.		
Woods ...	2—4,000	R	...		
Shady woods ..	1—3,000	R	...	...	
Open .	4 5,000	R	..	...	
Wet open ..	15—16,000		...	T.	
Damp woods	6—7,500	R	.	...	
Open ...	1—3,500	R.	...		
Wet ..	2—4,000	R.	..	...	
Open ...	1—6,000	R.	..	...	
Do .	1—4,000	R.	...	...	
Do. ..	1—3,000	R.	.	...	
Do. ...	3,000	R	...	...	
Do ...	4—6,000	R.	...	...	
Forest ...	1—3,500	R	...	..	
Do ...	1,000	R	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom.)	Habit of growth.	Height of plant.	Colour of flower	Time of flowering.	Locality.
7. Gmelina.						
arborea, *Roxb* ...	..	Tr.	40′—50′	Y.	March ...	Bhábar ..
8 Vitex						
Negundo, *L* .	...	Sh	10′—15′	Pr.	April ..	Bhábar, outer hills
9 Clerodendrum.						
infortunatum, *L* ..	1	Sh	6′	Pk	February,	Bhábar .
gratum, *Wall* ...	2	Sh	6′	Sc W.	March ...	Naini Tál, outer hills
serratum, *Spreng* ...	3	H.	3′	Pr.	June ...	Bágesár ...
10 Holmskioldia						
sanguinea, *Retz* ...	...	Sh	15′	Sc	December,	Kálápathar ..
11. Caryopteris						
Wallichiana, *Schauer* ,	...	Sh	10′—12′	Pk.	February,	Bhábar, Bágesar
LXXXVIII – -LABIATÆ						
1 Geniosporum						
strobiliferum, *Wall* ,	...	H.	1½′	Pr.	August ...	Sarju valley ...
2 Orthosiphon						
virgatus, *Benth* ...	1	H	1′		May .	Bágesar ...
rubicundus, *Benth.* . .	2	...	1′	Pk.	August ...	Kosi valley ..
3. Plectranthus						
ternifolius, *Don* ..	1	H.	3′—4′	...	October ..	Bhábar, Sarju valley.
rugosus, *Wall.* ..	2	Sh	4′	..	..	Naini Tál ...
Coetsa, *Don* ..	3	H.	3′	Li.	February,	Kota Dun, Almora.
cordifolius, *Don* .	4	H	3′	Bl.	..	Almora .
scrophularioides, *Wall.*	5	H.	3′—4′	W Y.	August ..	Kálimundi
Gerardianus, *Benth.*.	6, 10	H.	1′—3′	Wh	October ...	Gori valley, Almora
Maldoni, *Benth* ..	7	H.	4′	Li.	August .	Ká'imundi .
Striatus, *Benth* .	8	H.	2′	...		Almora .
Stracheyi, *Benth*	9	H.	1½′	Li	October ..	Sarju valley ..

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	Himálaya.		Tibet	Remarks.
		Rainy.	Dry.		
Forest .	1,500	R	..	..	
Open ...	1—4,000	R	...	..	
Forest ..	1,500	R	...	..	
Woods ..	4—6,500	R	.	..	
Open ..	3—4,000	R	...	...	
Woods ...	2—3,000	R.	.	...	
Do. ...	1—3,000	R	...	...	
Open ...	4,000	R.	...	...	
Do. ..	3,000	R.	...	..	
Do. ...	4,000	R	..	..	
Do. ...	1—3,000	R.	...		
Do. ...	5—7,000	R	...	...	
Do ...	2—6,000	R	.	.	
Do ...	5,500	R		...	
Woods .	8,700	R.	...	.	
Woods & Open,	5—7,000	R.	...	..	
Woods ...	8—9,000	R	...	..	
Open ...	5,000	R.	...	...	
Wet places	4,000	R	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower.	Time of flowering	Locality.
4 Coleus.						
barbatus, *Benth.* ...	..	H.	2′	Bl	.	Almora .
5. Anisochilus.						
carnosus, *Wall.* .	.	H.	1′	..	November,	Byás-ghát .
6. Pogostemon						
plectranthoides, *Desf*	1	Sh.	5′	.	March ...	Bhábar .
parviflora, *Benth*	2	Sh.	10′—15′	Pr	May .	Kapkot .
7. Dysophylla.						
cruciata, *Benth* ..	..	H.	2′	..	...	Almora ..
8. Colebrookia.						
oppositifolia, *Sm.*	.	Sh.	8″—12″	Wh.	March ...	Bágesar ...
9 Elscholtzia.						
polystachya, *Benth.* .	1	Sh.	4′—8′	Wh.	September,	Naini Tál ..
eriostachya, *Benth*	2	H	1′-1½′	Y	August .	Milam, Rálam,
densa, *Benth.* .	3	H.	1′—1½′	Y.	August ..	Rálam .
strobilifera, *Benth*	4	H	2′	Y.	August ...	Naini Tál, &c.,
pusilla, *Benth* .	5	H	4″—6″	?	August .	Topidhunga .
flava, *Benth*	6	Sh.	8′—10′	Y.	September.	Tunghási .
incisa, *Benth* .	7	H.	1′—1½′	Y.	August ...	Bhainskhet
pilosa, *Benth*	8	H	3′	Bl	October .	Sarju valley
cristata, *Willd.*	9	H	3′	.	October ..	Jalat ..
sp ——	10	H	1′	...	October ...	Sarju valley .
10 Perilla.						
ocymoides, *L.*	...	H	2′	Wh.	August ..	Bhábar, Dwáli,
11. Mentha.						
sylvestris, *L.*	...	H	2′	Pk.	August .	Níti .
12 Origanum.						
normale, *Don* .	1	H.	2′	Pk.	August .	Almora ...
vulgare, *L.*	2	H	2′	Pk.	August ...	Milam ..

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	Himalaya.		Tibet.	Remarks.
		Rainy.	Dry.		
Open	4—5,500	R	..	.	
Do	1,500	R	...	..	
Forest	1—3,000	R	...	...	
Open	3,500	R		..	
Wet, open	5,000	R	...	.	
Open	1—5,500	R	..	...	
Open	0—9,500	R	...	...	
Do	12—13,000	R	D.	...	
Do	10—12,000	R	D	...	
Do.	8—10,000	R	..	...	
Do.	15,000	.	...	T.	
Do	5,500 —9,500	R.	...	..	
Banks	4—6,500	R	...	..	
Open	4,000	R	...	...	
Woods	6—7,000	R	...	...	
..	4,000	R.	...	...	
Cultivated	1,5—8,500	R.	...	...	
Open	11,500	...	D.	...	
Do.	5,900	R.	...	...	
Do.	11,500	...	D.	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
13 Thymus.						
Serpyllum, *L* ...	1	H.	4″—5″	Pk.	August ..	Rálam, Rajhoti,
linearis, *Benth.* ..	2	H.	4″—5″	Pk.	March	Almora
14 Micromeria.						
biflora, *Benth.* ..	..	H.	6″—8″	Pk.	August ...	Almora ..
15. Hedeoma						
nepalensis, *Benth.*	...	H.	2′	...	August ..	Almora ..
16. Calamintha						
Clinopodium, *Benth.*	1	H.	1′	Bl.	August ...	Rálam ...
umbrosa, *Benth.* ..	2, 3	H.	2′	Bl.	August ..	Naini Tál, Almora.
17 Melissa.						
flava, *Benth* ..	1	H	2′	Y. Bl.	June ...	Binsar ..
parviflora, *Benth.* ..	2	H.	2′	...	August ..	Rámganga and Gori valley
18. Salvia						
lanata, *Roxb.* ..	1	H.	6″—12″	Bl.	March ..	Almora, &c. ..
campanulata, *Wall.* .	2	H.	3′	Bl	June	Dwáli, Dugli .
glutinosa, *L.* ...	3	H.	3′	Y.	August ...	Niti ..
sp.—— ...	4	H.	4′	Bl	August ...	Naini Tál ..
plebeia, *Br.* ...	5	H	1½′	Bl.	March ..	Outer hills ..
lanceolata, *Willd.* ...	6	H.	1′	Bl.	August ...	Hawalbágh ...
19. Nepeta.						
ruderalis, *Ham.* ...	1	H.	2½′	...	February,	Hardwár, outer hills.
spicata, *Benth* ...	2	H.	2′	Pr.	February,	Milam, Rálam,
campestris, *Benth.* ...	3	H	3′	Pr.	August .	Jalat ..
graciliflora, *Benth.* ..	4	H	1′	...	February,	Hardwár .
Govaniana, *Benth.* ...	5	H.	4′	Y.	August ...	Rálam valley,
leucophylla, *Benth.* ..	6	H.	2′	.	...	Naini Tál ..
elliptica, *Royle* ...	7	H.	2′	Li.	September,	Do
discolor, *Royle* ...	8	H.	1′—1½′	...	August ...	Milam, Niti, Pass
supina, *Stev.* ...	9,10	H.	1½′	Bl.	September,	Rákas Tál ...
tibetica, *Benth.* ...	11	H.	3″—6″	Bl.	August ...	Kyungar Langar.
longibracteata, *Benth.*	12	H.	6″	Li.	September,	Balchha Pass. .

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himalaya*		Tibet.	Remarks.
		Rainy	Dry		
Open ...	12—15,000	R.	D.	T.	
Do. ...	5—8,000	R.	..	...	
Do. ...	5—7,000	R	...	...	
Near water ...	4,500	R.	...	...	
Open ..	12,000	R	...	...	
Do. ...	5—8,000	R.	...	.	
Woods ...	7,500	R	...	...	
Do ...	5—6,500	R.	...	...	
Open ...	4—8,000	R.	...	...	
Open woods ...	10—11,000	R	...	...	
Open ...	7—11,000	...	D.	...	
Do. ...	7,000	R.	...	...	
Do ...	1—5,000	R	...	...	
Naturalized ...	4,000	R	...	...	
Open ...	1—5,000	R.	...	...	
Do. ...	8,5—12,000	R	D.	...	
Do. ...	7,000	R.	...	...	
Do. ...	1,000	R	...	...	
Do. ..	8,500	R	.	..	
Do. ...	6,500	R.	...	...	
Do. ...	7,700	R.	...	.	
Do. ...	11—15,000	...	D.	T.	
Do. ...	15,500	...	...	...	
Do. ...	15—15,500	...	...	T.	
Do. ..	17,000	...	..	T	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
20. Dracocephalum						
acanthoides, *Edgew.*,	1	H.	6″	Y.	August ...	Kyungar ...
speciosum, *Benth* .	2	H	9″	Bl.	August .	Kalájawai .
21 Scutellaria.						
discolor, *Colebr.* ..	1	H	6″	Pk	August ..	Jágesar ...
linearis, *Benth*	2	H	4″	Rk Y	March ...	Almora ...
angulosa, *Benth.* .	3	H.	1′—1½′	Pk Y	March .	Almora, Naini Tál
sp.—— .	4	H.	2′	Pk	March ...	Do ...
repens, *Ham.* ...	5	H.	2′—3′	Pr	March ..	Kota Dún ...
prostrata, *Jacq.* ...	6	H	6″	Pr Y.	August ...	Milam ..
grossa, *Wall* ...	7	H	3′	Bl.	August ...	Gágar Pass ...
22 Brunella						
vulgaris, *L.* ...	...	H	6″—9″	Pr.	August ...	Naini Tál, &c.,
23 Marrubium.						
lanatum, *Benth.* ..	...	H	6″	Br.?	August ...	Shelshel ...
24 Craniotome						
versicolor, *Reich.* .	...	H.	2′	Pk, W	September,	Almora, &c. . .
25. Anisomeles.						
ovata, *Br.* ..	...	H.	2′ – 4′	Bl	August ...	Almora, &c ...
26 Colquhounia						
vestita, *Wall.*	...	Sh	4′—8′	Sc	June ...	Naini Tál, Gori valley.
27. Stachys						
sericea, *Wall.* ..	1	H.	2′	Li.	July ...	Almora ...
splendens, *Wall.* .	2	H	2′—3′	Li	July ...	Naini Tál . .
28. Leonurus.						
Cardiaca, *L.*	...	H.	2′—3′	Wh.	June ...	Naini Tál ...
29. Lamium						
amplexicaule, *L.* .	1	H	9″	Pr.	March ..	Almora, Naini Tál,
petiolatum, *Royle* .	2	H	1′—1½′	Wh.	May ...	Naini Tál, Sába.
rhomboideum, *Benth*,	3	H	9″	Wh.	September,	Kyungar, &c....
sp ?—— ..	4	H	6″	...	June .	Sagtia-deo ...
30 Roylea.						
elegans, *Wall.* . .	. .	Sh.	6′—8′	Br.	March ...	Almora, Naini Tál

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	Himálaya.		Tibet.	Remarks.
		Rainy.	Dry.		
Open	15,500		D	T	
Do.	14,000	R.	..	...	
Banks	4,5—6,500	R	..	..	
Open	5,400	R.	..	...	
Do	4—8,000	R.	...	...	
Do	5,000	R		...	
Wet shady, banks.	2,000	R.	...	...	
Open	11,500	...	D	.	
Woods	6 –8,000	R	D	...	
Open	6–10,000	R.	..	...	
Do.	16,000	..	...	...	
Banks	5—7,000	R.	.	...	
Open	1—6,000	R	..	..	
Do.	6—8,000	R	..	...	
Do	6 8,000	R	.	...	
Woods	7—8,000	R.	...	..	
Do	6,5—8,000	R.		.	
Open	5,000	R.	..	...	
Do.	7—9,000	R.	.	...	
Do.	13—15,000	..	D.	T.	
Do.	11,500	R	...	..	
Do.	5,000	R	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower.	Time of flowering	Locality.
31 Leucas.						
hyssopifolia, *Benth*	1	H.	1′	Wh.	May .	Bágesar, &c. ..
cephalotes, *Spreng*	2	H	1′	Wh	August ...	Háwalbágh, &c.
lanata, *Benth.* ..	3	H	6″—8″	Wh.	May ..	Almora ..
mollissima, *Wall* ..	4	H	1′	Wh	May ..	Almora, Naini Tál.
32 Leonotis.						
nepetæfolia, *Br.* ..	...	H	2′—3′	Sc.	January ...	Bhábar ..
33 Phlomis.						
macrophylla, *Wall* .	...	H	4′	Br. Pr.	August .	Rálam valley ..
bracteosa, *Royle*	...	H.	2′	Pr	July .	Sagtia-deo ..
34 Teucrium						
macrostachyum, *Wall*,	1	Sh	5′—10′	Pr.	October ..	Gori valley ..
quadrifarium, *Ham* ..	2	H.	2′—3′	Li.	August .	Naini Tál, &c.,
Royleanum, *Wall* ...	3	H.	2′—3′	Wh.	August .	Almora ?
laxum, *Don* .	4	H.	1′	Pk.	February,	Rámganga valley.
35. Ajuga.						
bracteosa, *Benth.* ...	1	H	3″—9″	Pk.	March ..	Almora, &c. .
Do —— .	2	H	6″—8″	Pk.	March ..	Háwalbágh .
Do —— .	3	H.	2′—3′	Bl	February,	Kota Dún ..
Do —— ..	4	H	1½″—2″	Y P.	May	Pindari .
Do —— ..	5	H cr	2″	...	May .	Lahúr ..
LXXXIX.—PLANTAGINACEÆ.						
1. Plantago.						
asiatica, *L.* ...	1	H.	6″	...	July ..	Naini Tál, &c,
Do —— ..	2	H.	4″—5″	..	June ..	Madhári Pass,
Do.—— ...	3	H	5″	...	July .	Niti .
Do.—— ..	4	H	1′—2′	...	May .	Naini Tál, &c.,
Do —— ...	5	H	1′	...	August ..	Rálam valley...
XC.—NYCTAGINACEÆ.						
1. Bœrhaavia.						
sp.—— .	1	H.	2′—3′	Pk.	July ..	Joshimath, Jelam.
sp.——	2	H	2′—3′	Pk	July ...	Tapuban ...
diffusa, *L.* .	3	H	2′—3′	Pk.	January ..	Kaládhúngi
XCI.—AMARANTACEÆ.						
1. Deeringia.						
baccata, *Moq.*	.	Sh	20′	...	October ...	Jyári ..

Plants—(continued).

Condition of soil, &c.	Elevation in feet above the sea	Himálaya.		Tibet	Remarks.
		Rainy	Dry.		
Open	3—4,000	R.	.	.	
Fields	1—4,000	R	..	..	
Open	4—5,000	R.	.	..	
Do.	5—6,000	R.	..	...	
Cultivated	1—2,000	R.	...	.	
Open	10,000	R	...	..	
Do.	9—11,500	R	...	...	
Woods	8,000	R.	..	...	
Open	5,800	R	.	...	
Do.	5,000	R	...	...	
Do.	4,500	R.	...	..	
Do.	4—8,000	R	...	...	
Do.	4,000	R	.	...	
Near water	1, 5—4,000	R	...	...	
Open	12,500	R.	..	...	
On rocks	8,500	R	...	...	
Open	5—7,000	R	..	..	
Do	9,500	R	..	...	
Do	11,500		D.	...	
Do.	5—11,000	R.	..	...	
Do	11,000	R	.	..	
Do.	7—9,000	R	D.	.	
Do.	7,000	R	...	..	
Do.	1—7,000	R.	...	..	
Woods	3,500	R	...	...	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant	Colour of flower.	Time of flowering.	Locality.
2 Celosia						
argentea, *L.* ...	...	H.	1′—2′	Pk W	March ...	Kálápathai, &c.
3. Amarantus.						
spinosus, *L.* ...	1	H.	2′	Gr.	August ..	Kota, Almora,
Anardana, *Ham.* ..	2	H	3′—4′	R Y	August	Káthi, &c. ...
caudatus, *L.* ..	3	H	3′—4′	R.	August ..	Almora, &c. ..
4. Cyathula						
capitata, *Moq.* ...	1	H	3′	...	August ..	Jágesar .
tomentosa, *Moq.* ...	2	Sh.	6′	...	June ..	Almora, &c ..
5. Pupalia.						
lappacea, *Moq.* ...	...	...	...	..	...	Káládhúngi .
6 Ærua.						
scandens, *Wall* ...	...	H.	2′—3′	Wh.	March ...	Outer hills ...
7. Achyranthes.						
sp —— ...	1	H.	3′—4′	Wh.	August ...	Lohàthal ...
argentea, *Lam.* ...	2	H	3′	Wh,	August ...	Háwalbágh ...
aspera, *L.* ...	3	H	4′	Wh.	August .	Naini Tál ..
8 Alternanthera						
sessilis, *R.Br.* ...	...	H. cr.	1″	..	August ...	Almora ..
XCII.—CHENOPODIACEÆ.						
1. Chenopodium.						
multiflorum, *Moq* ...	1	H.	2′—3′		August ...	Badarináth ...
album, *L.* .	2, 4, 5	H.	1′—2′	Gr	August ..	Tola, Almora,
sp —— ...	3	H		...	August .	Milam ..
sp.—— ...	6	H	. .	..	..	
Botrys, *L.* ...	7	H.	9″	...	...	Almora ...
2. Blitum.						
virgatum, *L.* ...	...	H.	9″	...	August ..	Malári ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya.* Rainy.	Dry.	Tibet.	Remarks
In fields ...	2—5,000	R	..	..	
Do ..	2—5,500	R	...	..	
Cultivated ...	4—9,000	R	..		
Do. ...	5—8,000	R	...	...	
Shady ...	6—9,000	R.	..	...	
Open ...	5—7,500	R	. .	...	
Do. ...	1,000	R.	..	...	
Do. ...	1—5,000	R	...	...	
Shady ...	6,500	R	.	...	
Do. . .	4,000	R	...	...	
Do. ...	4—7,000	R	...	..	
Open ...	4,000	R.	...	...	
Do. ..	10,000	...	D,	...	
In fields ..	5—11,500	R.	D	...	
Do. ...	11,500	. .	D.	...	
...	...	R.			
Cultivated ...	5,000	R.	...	...	
Open ...	10,500	..	D.	...	

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant	Colour of flower.	Time of flowering.	Locality.
3. Beta.						
vulgaris, *Moq* ...	...			..		...
var. orientalis ...	..	H.	..	...	.	Almora . .
4. Atriplex.						
sp —— ...	1	H	2″—3″	..	August	Topidhunga ..
sp —— ...	2.	H. cr.	3″	...	August .	Milam .
5. Eurotia.						
ceratoides, *C.A. Mey* ,	...	Sh.	1½′	...	August ...	Laptel, plains of Gugé.
6 Salsola						
Kali? *L.* ...	...	H	4″	..	August ...	Tisum ...
XCIII.—PHYTOLACCACEÆ						
1. *Phytolacca.*						
decandra, *L.* .	...	H.	1′	Gr	May ...	Bágesar, &c., ..
XCIV.—POLYGONACEÆ						
1. Polygonum.						
macrophyllum, *Don*,	1	H.	9″	Cr	June ..	Dudatoli, Chámi Pass
Brunonis, *Wall.* ..	2	H.	9″	Cr.	September	,Rálam, Pindari
vaccinifolium, *Wall.*	3	H.	4″	Cr.	August ..	Do &c ...
viviparum, *L.* .	5	H.	1′—1½	Pk	August ...	Rálam, Laptel,
var. ...	4	H	6″	Pk	August .	Valleys in Gugé.
var gracilimum,	6	H.	6″	Pk	June ..	Rogila ..
horridum, *Roxb.* ..	7	H.	3′—4′	Pk.	July ...	Bhim Tál ..
capitatum, *Don* ..	...	...	...	...	...	...
var. pingue ..	8	H cr.	4″	Pk	March ...	Almora, outer hills
nepalense, *Meisn* ..	9	H.	2′	Pk	May ...	Naini Tál, &c.
sphærocephalum, *Wall.*	10	H. cr	1′—2′	Pk Pr	May .	Kúthi ...
perforatum, *Meisn.* ...	11	H.	1′	Pk.	May ..	Naini Tál . .
amplexicaule, *Don* ...	...		...	.	May ...	
var ambiguum .	12, 14,	H.	3′	Pk.	. .	Do , Káthi, &c
var. oxyphyllum .	13	.	..	.	...	. .

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himalaya.* Rainy.	*Himalaya.* Dry.	Tibet	Remarks.
		...	..	...	
Cultivated ..	500	R	...	..	
Open	15,000	..		T.	
Do ...	13,000	..	D.	...	
Do. ...	15—16,000	..	..	T.	
Do. ...	15,000	...	.	T.	
Cultivated	3—7,000	R,	...	...	
Open ...	10—12,000	R.	..	...	
...	11—14,000	R.	D	..	
..	11,—13,000	R,	D.	..	
Open ..	11—14,5000	R.	D.	T.	
Open rocks ...	14—16,000	...	...	T.	
...	11,000	R	...	...	
Near and in water.	4,400	R	..	..	
...			..	..	
Open ..	5,000	R	..	..	
Do. ..	6—11,500	R.	...	...	
Forest ...	7—8,000	R.	..	..	
Do. ...	7,000	R.	...	...	
...	..	..	..	..	
Do.	6—8000,	R.	..	...	
..	...	...	..	...	

Name	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower	Time of flowering	Locality.
lanigerum, *R. Br.*			...	...	...	...
var. [illegible] .	15	H	2′	Pk.	July ...	Bhim Tál, Almora
flaccidum, *Roxb.* .	16	H.	3′	Wh	May ...	Pâgesar, near Náini Tál
Posumba, *Ham.*	17	H.	2′	R.	June .	Náini Tál, &c.,
strictum, *All*	18	H	2′	Pk	August	Sarju valley
Hamiltonii, *Spreng.*,	19	H.	2′	Wh	July .	Almora .
barbatum, *L.*	20	H.	2′	Pk	February,	Bhábar .
aviculare, *L* ..	.		..			
var diffusum	21	H cr	1′	Pk	August .	Milam
Dryandri, *Spreng*	22	H. cr	½″	Pk	May ..	Naini Tál, &c.
illecebroides, *Meisn*	23	H cr	½″	Pk.	March .	Outer hills
quadrifidum, *Ham.* ..	24	H	4′	Wh	June	Naini Tál
glabrum, *Willd*	25	H.	2′	Pk	July ...	Do., Kosi river
amphibium, *L.*	26	B	1′	Pk	June .	Do .
pterocarpum, *Wall* .	27, 28	H sc.	1′–5′	Wh.	August September	Almora, Naini Tál, Dhauli valley
polystachyum, *Wall*,	.	.	..	...	...	..
var. glabrum .	32	H	3′—4′	W	August ...	Vishnuganga valley
var. pubescens ...	33	H	3′–4′	Pk.	August ...	Rálam, Milam.
frondosum, *Meisn.*	34	Sh	8′	Pk,	May ..	Lâhur, Káthi
rumicifolium, *Royle*,	42	H.	1½′	Gr Y.	August	Rálam ...
var oblongum ..	35	H.	2′	?	May ..	Jhúni
chinense, *L* ..		...	.		...	...
var. Thunbergianum.	36	H.	1′—2′	Pk	May ...	Naini Tál ..
var. corymbosum ...	36½	H	1′—2′	Pk	May	Do. ..
filicaule, *Wall.* ...	.				..	.
var extenuatum ...	37	H cr	4″	Pk	August ...	Rálam, Milam.
delicatulum, *Meisn.* .	38	H	3″	Pk.	August ...	Gothing, Rálam
sp —— ..	39	H.	½″	R.	August ..	Barjikáng Pass.
sinuatum, *Royle* ..	40	H,	4″	Pk.	August ...	Rálam, &c. ...
recumbens, *Royle* ..	41	H cr	6″–9″	Pk,	August . .	Naini Tál, Dyári Pass.
nummularifolium, *Meisn*	43	H	6″	Pk	August ...	Barjikáng Pass.
perforatum, *Meisn.* ..	..	.	..	. .	...	...
var. glaciale ...	44	H	2″	Pk	August ..	Milam ...
humile, *Meisn.* ..	45	H	3″	Wh	August .	Rálam valley...
cognatum, *Meisn* ..			. .		..	
var alpestre ..	46	H	1½″	W,Pk.	August ..	Eomprás ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himalaya.* Rainy.	Dry.	Tibet.	Remarks.
...	.	..	...	...	
Near water	1,000	R.	.	..	
Do	3,000	R.	..	...	
Do.	4 6,500	R.	...	.	
Open	1,000	R	..		
Near water	4,000	R	..	...	
Open	1—2 000	R	.	..	
Do.	11,500		D.	.	
Do	5—7,000	R.	..	.	
Do	1—7,000	R		...	
In water	6,000	R	.	.	
Do.	1—6,400	R	..	...	
Do	6,400	R	...	.	
On bushes	5—7,000	R	.	...	
...	...			.	
Open	9—10,000	R	D.	.	
Do	9—12,000	R	D	.	
Near water	7—8,000	R		..	
Open	11,500	R		..	
Do	7,500	R		...	
..			.	.	
Near water	6—7,000	R	...		
Do	6—7,000	R	.	.	
..				.	
Open	12,000	R	D.	.	
Do	11,—13,000	R	D	.	
Do	14,500	R	D.	...	
Do	8,5—10,000	R	..	...	
On rocks	6—8,000	R	.	.	
Open	11,500	R.	.	...	
..		...	.	...	
Do	13,000	.	D	...	
Do	9,500	R.	..	..	
...		..	..		
Do.	14,500	..	D.	T.	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant	Colour of flower.	Time of flowering	Locality.
tortuosum, *Meisn*	...					
var tibetanum	47	H	½'	Pk.	August ..	Plains of Guge,
sp —	48	H.	1½'	..	August	Do. .
Olivieri, *Jaub & Spach*	49	H. &c	¼"	..	August .	Milam, Niti ...
2. Fagopyrum.						
esculentum, *Moench*	..	H.	2'—3'	Pk.	July .	Tola, &c .
cymosum, *Meisn* .	.	H	3'	Pk	August .	Chaur, Almora,
rotundatum, *Bab.*	..	H	2' 3'	Pk	July	Tola, &c, ...
XCV —ARISTOLO-CHIACEÆ						
1. Aristolochia						
saccata, *Wall.* ...	..	S. sc	8'—10'	Pr B.	May ...	Naini Tál, Mádhári Pass
XCVI —PIPERA-CEÆ						
1. Peperomia.						
reflexa, *L.* .	1	H.	2"	..	February,	Sarju river, Binsar.
Heyneana, *Miq* .	2	..	.	..	...	.
2. Piper.						
longum, *L.*	...	H.	.	.	...	The Bhábar ...
XCVII —LAURI-NEÆ						
1. Cinnamomum.						
Tamala, *Nees.* ...	...	S	10'—12'	Wh	May ...	Bágesar valley,
2 Machilus.						
odoratissimus, *Nees.*	1	Tr.	20'—30'	Gr Y	March .	Outer hills, &c,
var .	2	Tr.	40'	Gr Y	March ...	Do. Sarju river.
3. Phœbe.						
lanceolata, *Nees.* .	1	Tr	40'—50'	...	May ...	Basáni
pallida, *Nees.* ..	2	Tr	20'—30'	Wh	May .	Ják Pass .

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himalaya* Rainy.	*Himalaya* Dry	Tibet	Remarks.
...	.	.	...		
Open ..	15,500	..	...	T	
Do ..	15,000	..	..	T	
..		..	.	..	
Cultivated .	5—11,500	R	D	...	=*Polygonum* No. 29 in Herb S. and W
Open ...	5—7,000	R		...	=*Polygonum* No. 30 in Herb S. and W
Cultivated ..	7—11,500	R.	D	.	=*Polygonum* No. 31 in Herb. S. and W.
Forest ...	6,5—8,000	R	...	...	
Trees & rocks	3—6,000	R.	...	...	
...	...	...	..	..	
Forest ..	1—2,400	R	...	...	
Do ...	3—4,500	R.	..	...	=*C. albiflorum* in Herb. S. and W.
Do. ..	1—4,500	R	...	.	
Do .	4—6,500	R	.	.	
Do. ...	4,500	R.	...	...	
Do ..	5,000	R	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower	Time of flowering.	Locality.
4. Litsea.						
consimilis, *Nees* .	...	Sh.	15′—20′	Wh	March ..	Naini Tál ...
lanuginosa, *Nees*	..		.	...	...	?
5. Tetranthera,						
tomentosa, *Roxb*	1	..	...	..	.	Kosi river
monopetala, *Roxb* ...	2	..	.	.	March ..	Outer hills, Srinagar.
6 Daphnidium						
pulcherrimum, *Nees*,	1	..	.	...	April ..	Naini Tál, Binsar.
bifarium, *Nees* ...	2	Tr	25′—30′	.	May	Satráli valley,
sp —— ..	3	.	.	..	May .	Binsar ..
XCVIII.—THYMELACEÆ.						
1. Daphne.						
papyracea, *Wall.* ..	1	Sh	3′—4′	Wh	June ..	Naini Tál, Binsar, &c.
oleoides, *L.* ...	2	Sh.	4′—5′	W Y.	June .	Jelam ..
2 Wikstræmia						
virgata, *Meisn.* ..	..	Sh.	6′	Wh.	June .	Naini Tál, &c.
3 Stellera						
concinna, *Edgew.*	...	H.	1″—1½′	Pk.	June ..	Bampa ...
XCIX - ELÆAGNACEÆ						
1. Hippophæ.						
rhamnoides, *L* .	1	Sh	1′	...	...	Milam, plains of Gúgé
salicifolia, *Don* ..	2	T.	15′—20′	..	...	Dwáli, Gori river
2. Elæagnus.						
umbellata, *Thunb.* ...	1, 2	S T,	8′—20′	...	April ..	Almora, Naini Tál.
latifolia, *L.* .	3	T.	...	...	...	Kota Dún ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya.*		Tibet	Remarks.
		Rainy.	Dry.		
Forest ...	6—7,000	R	..	.	= *Tetradenia* in Herb. S. and W.
	. .	R.	. .	...	= *Daphnidium* No 4 in Herb. S & W.
Do ...	3,500	R	..	..	
Do. ..	1, 5—5,000	R	..	...	
Do ...	7,000	R	..	..	
Do ..	5,000	R.		...	
Do. ..	8,000	R		..	
Woods ...	6—9,000	R.	...	..	
Open ...	8,500	. .	D	...	
Woods ...	6—10,000	R.	D.	..	
Open ..	11,000	...	D.	...	= *Passerina* in Herb. S. & W.
Do. ..	12—15,000	..	D	T.	
Forest by water.	6,5—9,000	R		...	
Open ...	5—7,000	R.	. .	...	
Forest ...	2,000	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality
C.—LORANTHACEÆ						
1. Loranthus.						
longiflorus, *Desr*	1	Sh p	3′—4′	Sc	March	Bhábar
cordifolius, *Wall.*	2, 3	Sh p,	4′—5′	Br R.	March	Outer hills
pulverulentus, *Wall.*	4	Sh p	3′—4′	Y. Gr.	March	Bhábar, Bágesar.
vestitus, *Wall.*	5	Sh p	2′—3′	R.	May	Gángoli, Naini-Tál
ligustrinus, *Wall*	6	Sh p	2′—3′	Sc.	May	Bágesar
sp ——	7	Sh ?	...	...	...	Baisáni
2 Viscum.						
attenuatum, *DC*	1	Sh. p	1′—2′	...	June	Bhábar, Gangoli
album, *L.*	2	Sh p	1′—2′	...	May	Common
articulatum, *Burm.*	3	Sh p	4″—6″	..	May	Gágar &c
sp ——	4	Sh. p	1″	...	...	?
CI.—SANTALACEÆ						
1. Thesium						
multicaule, *Ledeb.*	..	H.	6″	Wh.	July	Binsar, Níti
2. Osyris.						
arborea, *Wall.*	...	Sh	5′—8′	..	March	Kalimat, &c.
CII.—EUPHORBIACEÆ.						
1. Euphorbia.						
pilulifera, *L.*	1	H.	3′—12″	Wh	Do.	Kaládhúngi
indica, *Lam.*	2	H.	1′—1½′	Pk.	August	Sarju river
Stracheyi, *Boiss*	5, 18	H.	3″	...	Do.	Barjikáng Pass
sp.——	6	H.	6″	...	Do	Karnáli river, Laptel.
sp. (E procera, *Bieb?*)	7	H.	1′—1½′	...	?	?
sp ——	8	H.	1′—1½′	..	June	Singjari
cognata, *Boiss.*	9, 10	H	1′—1½′	..	March	Kálimat, Námik
nepalensis, *Boiss*	11, 13 14	H.	1′	...	Do.	Almora
Maddeni, *Boiss.*	15	H.	4′	...	Do.	Naini Tál
sp ——	16	H.	8″—4″	...	June	Ramni

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya.* Rainy.	*Himá-laya.* Dry.	Tibet.	Remarks.
On ulmus ...	1—2,500	R.	...	..	
On dalbergia ...	4—5,000	R.	...	...	
On trees ...	1—3,000	R.	...	...	
On quercus ...	6—7,000	R.	...	...	
On trees ...	3,000	R.	...	...	
?	4,000	R.	. .	...	
On trees ...	1—5,500	R.	...	...	
On pyrus and ulmus.	3—7,500	R.	. .	..	
On quercus ...	6—7,000	R.	...	...	
?	?	R.	...	...	
Open ...	6—11,500	...	D.	...	
Do. ...	4—6,000	R.	...	...	
Do. ...	1,000	R.	...	...	
Do. ...	4—5,000	R.	...	...	
Do. ...	13,000	R.	...	...	
Do. ...	15—16,000	...	...	T.	
Do. ...	...	...	...	...	
Do. ...	9—10,000	R.	...	...	
Do. ...	6—8,000	R.	...	...	
Do. ...	5—6,000	...	...	...	
Do. ...	7,500	R.	...	...	
Do. ...	9,000	...	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower	Time of flowering.	Locality.
sp. ——	17	H.	4″—6″	...	July	Rimkim
sp ——	19	H.	1″	...	July	Raj-hoti, Bomprás.
sp. ——	20	H.	1″	...	May	Champwa
Royleana, *Boiss.*	*	Sh	10′	...	March	Sarju river &c,
2 Sarcococca						
saligna, *Mull.*	...	Sh.	4′	...	April	Naini Tál
3 Buxus						
sempervirens, *L.*	...	Tr.	20′	...	July	Rámni, Bagdwár.
4. Bridelia.						
stipularis, *Bl.*	1	Sh.	...	...	...	Bhábar
retusa, *Spreng.*	2	Tr.	25′	...	...	Sarju river
5 Andrachne.						
cordifolia, *Mull.*	...	Sh.	6′—8′	...	February,	Rámganga river.
6. Phyllanthus.						
Urinaria, *L.*	1	H.	3″—6″	...	July	Almora
Niruri, *L.*	2	H.	1′	...	September,	Bágesar
reticulatus, *Poir.*	...	Sh	10′	W. Gr.	August	Mohargári
Emblica, *L.*	...	Tr.	15′	...	March	Outer hills, Sarju river.
nepalensis, *Müll.*	...	Tr.	...	...	July	Bhábar, Sarju river.
sp ——	5	Sh.	3′—4′	...	July	Almora
sp ——	...	Tr.	15′	...	...	Kota
sp. ——	...	Sh.	15′—20′	Y.	May	Bágesar
7 —Securinega.						
obovata, *Mull.*	...	Sh.	3′—12′	W. Gr.	May	Bhim Tál, Kosi valley.
8. Putranjiva.						
Roxburghii, *Wall.*	...	Tr.	...	...	...	Bhábar
9. Daphniphyllum						
himalense	...	Tr.	30′	...	...	Gágar

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himalaya*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	14,000	...	. .	T	
Do. ...	15,000	.	D.	T.	
Do. ...	12,000	R.	. .	...	
Do. ...	2—4,000	R.	..	...	
Forest ...	7,000	R.	. .	. .	
Do. ...	8—9,000	R	...	...	
Do. ...	1,000	R.	...	...	
Do. ...	3,000	R.	...	...	
Open ...	8,500	L.	...	...	= *Leptopus cordifolius* in Herb. S. and W.
Wet ...	5,000	R	...	...	
Open ...	3,000	R	...	...	
Do. ...	4,500	R.	...	...	= *Fluggea* No. 1 in Herb S. and W
Do. ...	1—4,500	R.	...	...	= *Emblica officinalis* in Herb. S. and W.
Forest ...	1—4,000	R.	...	...	= *Bradleia ovata* in Herb. S. and W.
Open ...	5,000	R.	...	...	= *Ph. juniperinus*, Wall. in Herb S. and W.
Forest ...	2,000	R.	...	...	= *Anisonema* in Herb S and W.
Do. ...	4,000	R.	...	...	= *Glochidion bifarium*? in Herb. S. and W.
Open ...	4 - 5,000	R	..	...	= *Fluggea* Nos. 2 and 3 in Herb. S. and W.
Forest ...	1,000	R.	...	...	
Do. ...	6—7,000	R.	...	...	= *Goughia* in Herb. S and W.

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
10. Antidesma.						
diandrum, *Tulasne* ...	...	T.	...	...	...	Kota Dún ...
11. Jatropha.						
Curcas, *L.*	..	...	...	..	...	Bhábar ...
12. Acalypha.						
calyciformis, *Wight,*	...	H.	1'	...	September,	Dhánpur ...
13. Adelia.						
sp.—— ...	...	Tr.	30'	...	February,	Outer hills, Sarju valley.
14. Trewia.						
nudiflora, *L.* ...	...	Tr.	20'—30'	Gr. Y.	March ...	Bhábar ...
15. Mallotus.						
philippinensis, *Mull.,*	...	Tr.	25'	...	December,	Sarju river ...
16. Ricinus.						
communis, *L.* ...	...	Sh	8'—12'	R	...	...
17. Excæcaria.						
acerifolia, *Müll.* ...	...	Sh.	4'—5'	...	All the year.	Kapkot, Gangoli
insignis, *Mull.* ...	...	Tr.	20'—30	Y.	January ..	Outer hills, Sarju river.
CIII – URTICACEÆ.						
1 Ulmus.	1	Tr.	40'—60'		March ...	Bhábar ..
integrifolia, *Roxb.* ...	1½	Tr.	30'—40'	...	February,	Bágesar ...
parvifolia, *Jacq.* ...	..	Tr.	.	...	...	..
campestris, *L* ...	2	Tr.	30'—40'	...	March ...	Naini Tál ...
var macrophylla ..	3	Tr.	50'	...	April ...	Dwáli ...
" —— ..				...		
2 Celtis.						
australis, *L.* ...	2, 3	Tr.	25'—40'	...	March ...	Kota, Námik, Almora.
eriocarpa, *Dcne.* ...	4, 5	Tr.	20'		March ..	Kota, Almora, &c.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya.*		Tibet.	Remarks.
		Rainy.	Dry		
...	2,500	R.	...	..	
Forest ...	2,000	R.	...	..	
Open ...	8,000	R.	...	...	
Forest ...	2—3 000	R.	...	...	
Do. ...	1—2,000	R.	..	...	
Do. ...	1—4,000	R.	...	..	=*Rottlera* in Herb. S. and W.
Cultivated ...	2,000	R	...	...	
Open ...	3,5—5000	R.	...	...	=*Sapium sp.* in Herb. S. and W.
Do. ...	2—5,000	R.	...	...	=*Falconeria* in Herb. S. and W.
Forest ...	1,000	R	...	...	
...	3,500	R.	..	...	
...	..	...	...	...	
...	7,000	R.	...	..	
...	8,500	R.	...	...	
Forest ...	2—6,500	R.	...	...	
Do. ...	2—5,000	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Habit of plant.	Colour of flower.	Time of flowering.	Locality.
3. Sponia.						
politoria, *Planch* ...	...	Sh.	10′	...	December,	Kálapathar ...
4. Cannabis.						
sativa, *L.* ..	...	H.	8′—18′	...	September,	Almora, &c. ...
5. Streblus						
asper, *Lour.* ...	...	Tr.	25′	Wh.	March ..	Bhábar ...
6. Morus.						
lævigata, *Wall.* ..	1	Tr.	30′	...	February,	Kota ...
indica, *L.* ...	2, 4	Tr.	20′	...	February,	Do. ...
serrata, *Roxb.* ..	3	Tr.	44′	...	May ...	Námik ...
7. Ficus.						
cordifolia, *Roxb.* ...	1	Tr.	15′	...	...	Kota ...
religiosa, *L.* ...	2	Tr.	60′	...	...	Do., &c. ...
virgata, *Roxb.* ...	3	Tr.	15′	...	...	Bhábar, Almora.
sp.—— ...	4	Tr.	20′—30′	...	...	Kota ...
retusa, *L.* ...	5	Tr.	30′	...	...	Kosi river ...
Roxburghii, *Wall.* ...	6	Tr.	15′	..	...	Rámganga river
infectoria, *Roxb.* ..	7	Tr	40′	...	...	Píndar river ...
conglomerata, *Roxb.* ...	8	Tr.	15′	...	...	Rámganga river.
tuberculata, *Wall.* ...	9	S sc	15′	...	...	Sarju ...
hispida, *L f.* ...	10	Tr.	20′	...	...	Bhábar ...
indica, *L.* ...	11	Tr.	60′	..	...	Kota Dún, &c.,
pubigera, *Wall.* ...	12	S. sc	30′—40′	...	...	Below Gangoli Bágesar
scandens, *Roxb.* ...	13	S sc.	50′	...	...	Bágesar ...
foveolata, *Wall.* ..	14	S. sc	30′	...	...	Naini Tál, Dhauli river.
parasitica, *Kœn.* ...	15	S. sc.	30′	...	...	Káládhúngi ...
sp.—— ...	16	?	...	...	...	?
sp —— ...	18	Tr.	...	...	...	Outer hills ...
sp —— ...	19	Tr.	30′	..	...	Pyura ...
sp.—— ...	20	Fr.	40′	...	...	Bhábar ...

Plants—(continued).

Conditions of soils, &c.	Elevation in feet above the sea.	*Himá-laya*		Tibet.	Remarks.
		Rainy.	Dry.		
Open	2,000	B.	...	...	
Do.	2—5,000	R.	...	...	
Forest	1,000	R.	...	...	=*Epicarpus* in Herb S. and W.
Do.	2,000	R.	...	...	
Open	500—2,000	R.	...	...	
Forest	5—9,000	R.	...	...	
Do.	1—5,400	R.	...	...	
Do.	1,500	R.	...	...	
Open	1—4,000	R.	...	...	
Do.	3—5,000	R.	...	..	=*F. brachycarpa*, *Miq.*, in Herb. S and W.
Do.	3,000	R.	...	...	
Do.	2—5,000	R.	...	...	
Do.	500—4,000	R.	...	...	
Do.	500 4,000	R	...	...	
On rocks	2,500	R.	..	...	
Forest	1—2,000	R	...	...	
Open	1,000	R	...	...	
Do and Forest.	2,500—3,000	R.	...	...	
Forest	3,000	R.	...	...	
On rocks	6—7,000	R.	...	...	
Open	1,000	R.	...	...	
...	...	R.	...	...	
Forest	4,000	R.	...	...	
Open	6,000	R.	...	...	=*F. densa*, *Miq.*, in Herb. S. & W.
Forest	1,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
8. Artocarpus.						
Lakoocha, *Roxb.* ..	Tr.	...	30′—40′	...	...	Near Kota ...
9. Urtica.						
parviflora, *Roxb.* .	1, 3, 16	H.	3′—8′	...	February, July.	Páton, Kota ...
dioica, *L.* ...	2, 15	H.	4′	...	...	?
hyperborea, *Jacquem.*,	4, 18	H.	1′—2′	...	August ...	Kyungar ...
10. Laportea.						
evitata, *Wall.* ...	...	H.	3′	...	July ...	Jalat ...
11. Girardinia.						
heterophylla, *Dcne* ...	...	H.	10′	...	August ...	Páton ...
12. Pilea.						
umbrosa, *Wedd.* ...	1	H.	1′—2′	...	July ...	Binsar ...
scripta, *Wedd.* ...	2	H.	3′	...	...	Do Gágar ...
trinervis, *Wight* ...	3	H.	1½′	Wh	August ...	Kálimundi ...
13 Lecanthus.						
Wightii, *Wedd.* ...	...	H.	2″—3″	Pk.	August ...	Rámganga river, Jagesar.
14. Elatostemma.						
obtusum, *Wall.* ...	1	H.	6″	...	June ...	Káthi, Láhur...
sessile, *Wedd.* ...	...	...	...	...	...	
var. polycephalum,	2	H.	1′	...	August ...	Naini Tál, Námik.
„ cuspidatum ...	3	H.	1′—2′	...	May ...	Lahur ...
diversifolium, *Wall.*...	4	H.	6″	...	August ...	Lohathal ...
Stracheyanum, *Wedd.*,	5	H.	8″	...	June	Tola, Binsar ...
sp. —— ...	6	H.	4′—6′	...	February,	Sarju river ...
15. Bœhmeria.						
platyphylla, *Wedd.* ...	1, 2, 3, 6	H. or S.	1′—10′	...	May to August.	Dhakuri-bináyak, Bágesar, Sarju river, Almora.
macrophylla, *Don* ..	4	S.	6′—10′	...	August ...	Sarju river ...
rugulosa, *Wall.* ...	7	Tr.	20′	Wh.	...	Ditto ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya* Rainy.	*Himá-laya* Dry.	Tibet	Remarks.
Forest ..	3,000	R	...	...	
Open ..	2,5—10,000	R	.	.	
Do ...	...	R	. .		
Do. .	14—17,500	...	D	T	
Woods ..	7,000	R.	.	.	= *Urtica* No 2 in Herb. S. and W.
Open ...	4—9,000	R.	. .	...	= *Urtica* No. 9 in Herb. S. and W.
Woods ...	5—8,000	R	. .	...	= *Urtica* No. 1 in Herb S. and W.
Do by water,	5—7,500	R	.	...	= *Urtica* No 19 in Herb. S. & W.
Woods ...	8,700	R.	...	..	= *Urtica* No. 17 in Herb. S. and W.
Damp shade ...	4—9,000	R.	...	..	= *Procris* Nos 3, 4, 8, & 9 in Herb. S. and W.
Wet banks ...	7,000	R.	...	...	= *Procris* No 1 in Herb. S. & W.
Do. .	7—8,000	. .	. .	...	= *Procris* No 7 in Herb. S & W.
...	..	..	...	...	= *Procris* No. 6 in Herb. S. and W.
Ditto ...	6—7,500	R.	...	...	= *Procris* No 2 in Herb. S & W
Ditto ..	5—6,500	R.	...	...	= *Procris* No. 5 in Herb. S. & W.
Wet shady rocks.	4,000	R.	. .	..	= *Urtica* No. 23 in Herb. S. & W.
Forest & open,	2—7,500	R.	. .	..	= *Urtica* Nos. 4, 5 and 20 in Herb S. and W
Open ...	2—4,000	R.	...	...	= *Urtica* No. 7 in Herb. S & W.
Ditto ..	3—5,000	...	...	...	= *Urtica* No 21 in Herb S & W

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
16 Chamabaina.						
cuspidata, *Wedd.* ...	...	H.	9″	Pk.	August ..	Mohargári, Tungnáth.
17. Memorialis.						
ciliaris, *Wedd.* .	...	H.	1½′	...	...	Baijnáth ..
18. Pouzolzia.						
ovalis, *Wedd.* ..	1	...	...	...	...	?
quinquenervis, *Bl.* ..	2	H.	4′	...	August ...	Almora ...
19. Villebrunia						
frutescens, *Bl.* ..	...	Sh.	10′—15′	...	...	Bágesar ...
20. Debregeasia.						
velutina, *Wedd.* ...	1	Sh.	5′—15′	...	August ..	Gori river, Sarju river
hypoleuca, *Wedd.* ...	2	Sh	15′	...	March ...	Rámganga river.
21 Maoutia.						
Puya, *Wedd.* .	...	Sh.	5′	...	August ..	Sarju valley ...
22. Parietaria.						
debilis, *Forsk.* ..	...	H.	1′	...	September,	Below Milam & Badarináth.
CIV.—JUGLANDACEÆ.						
1. Juglans.						
regia, *L.* ...	...	Tr	40′—50′	...	March ...	Dwáli ...
2. Engelhardtia.						
Colebrookiana, *Lindl.*,	1	Tr.	30′—40′	...	March ..	Kota, Bágesar.
sp —— .	2	Tr.	...	...	...	?
CV.—MYRICACEÆ.						
1. Myrica.						
sapida, *Wall.* ...	...	Tr	20′—30′	...	April ..	Suring, Almora.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himálaya.*		Tibet.	Remarks.
		Rainy	Dry.		
Wet banks ..	6—10,000	R.	...	..	= *Urtica* No 8 in Herb. S. & W.
Open ...	3,500	R.	...	..	
...	?	...	...	...	= *Urtica* No 24 in Herb. S. & W.
Open banks ..	5,000	R.	...	...	= *Urtica* No. 10 in Herb. S. & W.
Forest ...	3—5,000	R.	...	...	= *Urtica* No. 22 in Herb. S. & W.
Open ...	2, 5—5,000	R	...	...	= *Urtica* Nos. 12 and 13 in Herb. S. and W.
Ditto ...	3—5,000	R.	...	...	= *Urtica* No. 14 in Herb. S. & W.
Banks ...	2—4,000	R.	...	...	= *Urtica* No. 11 in Herb. S. & W.
Open ...	8,500—13,000	R.	D.	...	
Forest ...	4—8,500	R.	...	...	
Do ...	2—5,000	R	...	...	
?	?	R.	...	...	
Open ...	5—6,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant	Colour of flower	Time of flowering.	Locality.
CVI.—CUPULIFERÆ						
1. Carpinus.						
viminea, *Wall* ...	1	Tr.	50′	...	March ...	Naini Tál, Binsar
faginea, *Lindl.* ...	2	Tr.	50′	..	March ..	Naini Tál, Binsar.
2 Corylus.						
Colurna, *L* ...	...	Tr	50′	...	May .	Dwáli Tonghári.
3. Quercus.						
semicarpifolia, *Sm.*	1	Tr	100′	..	April ...	Chína, Káthi, &c
lanuginosa, *Don* ...	2	Tr.	40′	...	April ...	Naini Tál, Binsar.
dilatata, *Lindl.* ...	3	Tr.	60′	...	April ..	Naini Tál, Binsar
incana, *Roxb.* ...	4	Tr	60′	...	March ..	Ubique ...
annulata, *Sm.* ..	5	Tr	50′	...	March ...	Bágesar valley,
4 Castanea						
tribuloides, *A.DC.* ...	...	Tr.	40′	...	August ...	Gangoli, &c. ...
5 Betula.						
Bhojpattra, *Wall.* ..	1, 2	Tr	15′—30′	..	May ...	Champwa, &c ,
acuminata, *Wall.* ...	3, 4	Tr.	40′—60′	..	April ...	Binsar, Naini Tál.
6. Alnus.						
nepalensis, *Don* ..	...	Tr.	30′—40′	...	October ...	Binsar, Naini Tál.
CVII.—SALICINEÆ.						
1. Salix						
acutifolia, *Willd.* ...	1	Sh.	12′	...	...	Rámni, Betuli Pass
elegans, *Wall.* ..	2, 6, 7	Sh.	6′—15′	...	May, June,	Naini Tál, Dugli, Námik, Niti
tetrasperma, *Roxb.* .	4	Tr.	25′	...	May ...	Satráli valley,
Wallichiana, *Anders.*,	3, 11	Sh	12′	..	April ...	Gágar ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himálaya*		Tibet.	Remarks.
		Rainy	Dry		
Forest ...	7—8,000	R.	..	...	
Do. ...	7,000	R.	...	..	
Do. ...	7—9,000	R	...	...	
Do. ...	7—11,500	R	.	...	
Do ...	7—8,000	R	...	...	
Do. ...	6, 5—9,000	R.	...	...	
Do. ...	4, 5—7,500	R.	...	...	
Do. ...	3—5,000	R	...	...	
Do. ...	4—6,000	R.	...	...	
Do. ...	11—12,000	R	D.	T.	
Do. ...	6—8,000	R.	...	..	
Do. ...	4—9,000	R.	...	...	
Do. ...	8—10,000	R	...	...	
Do. ...	7—11,500	R	D.	..	
Open ...	1—4,500	R.	...	...	
Forest ...	5—6,500	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower.	Time of flowering.	Locality.
Grisea, *Wall.* ..	5	Sh.	15′	...	April ...	Gágar, Sarju valley.
sclerophylla, *Anders.*,	8, 10	Sh	3′—10′	...	July ...	Rimkim, Rajhoti
Lindleyana, *Wall.* .	12, 14	Sh.	2″—2′	...	June, July,	Pindari, Barjikáng Pass.
furcata, *Anders.* ...	13	Sh	9″—12″	...	May ...	Pindari, Barjikáng Pass.
CVIII.—GNETACEÆ						
1. Ephedra.						
vulgaris, *Rich.* ...	...	S.	1′—2′	..	June ..	Pindari, .. Milam, Tibet.
CIX.—CONIFERÆ.						
1. Cupressus.						
torulosa, *Don* ...	...	T.	100′	...	February,	Naini Tál ...
2 Juniperus.						
excelsa, *M. Bieb.* ...	1	T.	20′—30′	...	June ...	Milam, Malári,
recurva, *Don* ...	2	Sh	4′	...	June ...	Dugli, &c ...
var. squamata, Wallichiana, *Hf. & T.*	3	Sh.	5′	...	May ...	Pindari, Milam.
communis, *L.* ...	4	Sh.	4′	...	May ...	Milam, Rimkim.
3. Taxus.						
baccata, *L.* ...	...	T.	50′	...	April ...	Dwáli, &c. ...
4. Pinus.						
longifolia, *Roxb.* ...	1	T.	100′	...	February,	Ubique ...
excelsa, *Wall.* ...	2	T.	100′	...	May ...	Above Joshimath.
5. Cedrus.						
Deodara, *Loud* ...	...	T.	150′	...	September,	Jelam ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himalaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	5—6,500	R.	...	...	
Do. ...	13,500 —15,500	...	D.	T	
Do. ...	11—14,000	R.	..	...	
Do ...	12,000	R	...	.	
Open ...	9—16,000	R.	D.	T.	
Forest ...	4,5—9,000	R	...	...	
Open ...	9—14,000	...	D.	T.	
Do. ...	10,500	R.	...	T	
Do. ...	9—14,000	R	D,	...	
Do. ...	9—14,500	...	D.	T.	
Forest ...	7—11,000	R.	D.	...	
Open forest ...	2—7,500	R.	...	...	
Do. ...	5—11,500	R.	D.	...	
Forest ...	9—11,500	R.	D.	...	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth	Height of plant.	Colour of flower.	Time of flowering.	Locality.
6. Abies.						
Webbiana, *Wall.*	2	T.	150′	...	May	Champwa, Dwáli
var Pindrow	1	T	150′	..	May	Káthi, &c
Smithiana, *Wall.*	3	T	150′	.	April,	Above Joshimath.
CX.—HYDROCHARIDEÆ						
1 Hydrilla.						
verticillata, *Rich.*	...	H.	...	...	...	Bhim Tál, Naini Tál.
2. Vallisneria.						
spiralis, *L*	...	H.	...	...	...	Bhim Tál, Naini Tál.
CXI.—SCITAMINEÆ.						
1. Globba.						
orixensis, *Roxb.*	...	H.	3′	Or.	...	Dyári Pass, Háwalbágh.
2. Zingiber.						
capitatum, *Roxb.*	1	H.	4′	Y.	August	Sarju valley ...
chrysanthum, *Rosc.*	2	H.	4′	Y.	August	Mohargári
3 Curcuma.						
longa, *Wall.*	...	H.	1′—2′	Or.	August	Bágesar ...
4. Roscoea.						
purpurea, *Sm*	1	H.	1′—1½′	Pr	May	Naini Tál
alpina, *Royle*	2	H.	4″—6″	Pr.	June	Karim Pass, China.
gracilis, *Sm.*	3	H.	1′—1½′	...	June	Naini Tál ...
elatior, *Sm*	4	H.	2′	Y.	August	Kálimundi ...
5. Hedychium.						
coccineum, *Sm.*	1	H.	5′	S. O.	August	Jágesar ...
spicatum, *Sm.*	...	...	...	...	...	...
var elatum	2	H.	5′	W. Pk.	August	Naini Tál
densiflorum, *Wall*	3	H.	4′	W. Pk.	July	Near Bágesar...
ellipticum, *Sm.*	4	H.	3′	Y.	August	Do ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himalaya.* Rainy.	*Himalaya.* Dry.	Tibet.	Remarks.
Thick forest ...	9,5—11,000	R	...	...	
Do ...	7,5—10,000	R	D.	...	
Forest ...	6—11,000	...	D.	...	
In water ...	4—6,400	R	...	...	
Do. ...	4,400	R.	...	...	
Woods ...	4—7,000	R.	...	...	
Open ...	2,500	R.	...	...	
Banks ...	3—4,500	R.	...	...	
Open ...	3—6,000	R.	...	...	
Woods ...	6—7,500	R	...	...	
Open ...	7—11,000	R.	...	...	
On trees ...	6—7,000	R.	..	...	
Woods ...	8,500	R.	...	...	
Open ...	4—5,000	R.	...	...	
...	.	...	...	...	
Woods ...	5—8,000	R.	...	...	
Banks ...	5,000	R.	..	...	
Open ..	3—4,000	R.	...	..	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
6. Costus.						
speciosus, *Sm.* ..	...	H.	3′	Pr.	August ..	Sarju valley ...
7. Musa						
sapientum, *L.* ..	...	H	6′—8′	..	?	Sarju and Káli river.
CXII.—ORCHIDEÆ.						
EPIDENDREÆ.						
1. Oberonia						
iridifolia, *Lindl.* ...	2	H.	4″—6″	...	...	Bhábar, Bágesar,
2. Empusa						
paradoxa, *Lindl.* ..	3	H	9″	G. Y.	August ..	Lohathal ...
3 Dienia.						
cylindrostachya, *Lindl.*,	4	H.	1′	G. W	August ..	Jágesar ...
4 Liparis.						
nepalensis, *Lindl.* .	1	H.	8′	...	July .	Binsar .
5. Phalidota.						
articulata, *Lindl.* ...	17	H.	4″	Pk.	July ...	Bágesar, outer hills.
imbricata, *Lindl.* ...	16	H.	1′—1½′	Wh.	August .	Rámganga river, Sarju.
6 Cœlogyne						
elata, *Lindl* ..	14	H.	1′—1½′	..	May	Sarju river .
cristata, *Lindl.* ...	15	H.	1′	Wh.	April .	Champáwat, &c
7. Bolbophyllum.						
umbellatum, *Lindl.* ...	10	H.	4″	..	...	Rámganga river
8 Cirrhopetalum						
Wallichii, *Lindl.*	11	H.	3″	...	...	Bágesar valley,

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himálaya*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	7,500	R	...	.	
Woods ..	3–4,000	R.	.	..	
On trees	1—3,500	R	..	...	
Open ..	6,000	R.	..	...	
Do ..	7,000	R.	...	...	
On trees .	7,500	R	...	...	
Do ...	3—3,500	R	...	...	
Do. ..	3,500	R	...	...	
Do. ...	3,700	R.	..	...	
Do. ...	5,500	R.	...	...	
Do. ...	3,500	R.	...	...	
Do. ...	3,700	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
9. Eria.						
excavata, *Lindl.* ..	12	H.	6″	Wh.	August ...	Jágesar ..
sp —— ..	13	H.	6″	Gr Y.	August ..	Mohargári ...
10. Dendrobium.						
denudans, *Don* ..	5	H	3″		September,	Jalath
sp —— .	6	H	1′	Or.	May ..	Jagthána, &c,
sp. —— ..	7	H.	.	...	...	...
sp ——	8	H.	6″—8″	...	..	Rámganga river
sp —— ..	9	H.	2′	...	...	...
11. Phajus.						
albus, *Lindl.* ...	18	H.	½′	Wh.	August .	Bágesar valley,
12 Cymbidium.						
giganteum, *Swartz.*	26	H.	1½′	Br. R.	October ...	Bágesar valley,
13. Vanda.						
cristata, *Lindl.* ..	21	H	9″—12″	...	May ..	Bágesar, outer hills
sp —— ..	22	H.	...	...	May .	Bágesar .
14. Chiloschista						
sp. —— ...	23	H	6″	Pk	May ..	Below Binsar.
15. Saccolabium.						
guttatum, *Lindl.* ..	24	H.	1′	Pk.	July ...	Bágesar, outer hills
16. Aerides.						
affine, *Wall.* ...	25	H.	1′	Pk.	July ...	Bhábar, Bágesar.
TERRESTRIAL.						
17. Eulophia.						
rupestris, *Lindl.* ...	19	H.	9″	Pk.	May ..	Bágesar ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the area.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
On trees ..	6,000	R	...	...	
Do. ..	4,000	R.	...	...	
On rocks ...	4,700	R	..	...	
On trees ...	4,000	R.	...	..	
Do. ..	4,000 ?	R.	...	...	
Do ...	3,500 ?	R.	...	..	
Do. ...	4,000 ?	R.	..	...	
Do. ...	3,000	R	...	...	
Do. ...	4,000	R.	...	...	
Do. ...	3,500	R.	...	...	
Do. ...	3,000	R.	..	...	
Do. ...	3,500	R.	...	.	
Do. ...	3,000	R.	...	...	
Do. ...	1—3,000	R.	...	...	
Open ...	3,500	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
18. Cyrtoptera						
flava, *Lindl* .	26	H.	2′	Y.	July ..	Below Almora,
19. Calanthe.						
plantaginea, *Lindl.* .	27	H	1′	Pk.	May ..	Binsar, &c ..
20. Orchis.						
latifolia, *L.*, var. ...	28	H.	1′	Pk.	June ..	Kulára, Tola.
21. Gymnadenia.						
Chusua, *Lindl.* ..	35	H.	4″	Pk	June ..	Rogila ..
orchidis, *Lindl*	42	H.	1′—2′	?	August ..	Naini Tál ...
22. Aceras.						
angustifolia, *Lindl.* ..	29	H.	4″—6″	Gr.	August ...	Naini Tál ..
23 Platanthera.						
Susannæ, *Lindl.* ..	39	H	2′	Wh	August .	Almora.
obcordata, *Lindl* ..	40	H.	6″	Pk.	August ..	Kálimat, Jágesar
acuminata, *Lindl* ...	41	H.	6″	Wh	July ...	Almora, Naini Tál.
candida, *Lindl.* ..	44	H.	9″	Wh.	August ...	Bágesar, Lohathal
24. Hemipilia.						
cordifolia, *Lindl* ...	37	H.	5″	Pk.	August ..	Shaidevi Peak,
25 Peristylus.						
fallax, *Lindl.* ...	32	H.	1′	Gr Y.	August ...	Naini Tál, Rálam.
goodyeroides, *Lindl*,	33	H	1′—1½′	Gr.	July ...	Almora ...
26. Herminium						
gramineum, *Lindl* ...	31	H.	4″	Gr.	August ..	Kálimundi ? ...
congestum, *Lindl.* ...	34	H.	8″	Gr.	August ...	Tola ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himálaya.*		Tibet	Remarks.
		Rainy	Dry.		
Open ...	4,300	R.	...	..	
Woods ...	7—9,000	R	.	.	
Open ..	11,500	R	D.		
Do. ...	11,000	R	.		
Woods ...	7—8,500	R.	. .	.	
Open ..	5—7,000	R	...	..	
Do. ...	5,500	R.	.	. .	
Do. ...	6—7,000	R	..	.	
Do. ...	5—6,000	R.	...	.	
Do. ..	3—5,000	R.	...	...	
Do. ...	7,000	R	...	. .	
Do. ..	7—12,000	R.	.	...	
Do. ...	4,000	R	. .	. .	
Woods ...	8,500 ?	R.	...	..	
Open, Wet ...	11,500	...	D	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
27. Habenaria.						
plantaginea, *Lindl.* ..	30	H.	8″	...	August ...	Binsar ...
marginata, *Lindl.* ..	38	H.	6″	Y.	August ..	Almora ..
commelynæfolia, *Wall.*	43	H.	1½″	Wh.	August ..	Rámganga, river
intermedia, *Don* ..	45	H.	1′—1½′	Wh	August ...	Jágesar, Naini Tál.
pectinata, *Don* ...	46	H.	1′—2′	Y. G.	August ...	Naini Tál ...
28 Satyrium.						
nepalense, *Don* .	30	...	...	...	...	...
29. Cephalanthera						
acuminata, *Lindl.* ...	47	H.	9″	...	August ...	Rogila, Dudutoli
ensifolia, *Rich.* ...	48	H.	1′	...	August ...	Naini Tál ...
30. Listera.						
sp. ——— ...	49	H.	...	...	...	...
31. Epipactis.						
macrostachya, *Lindl.*	50	H.	1′—1½′	Y. Gr.	July ...	Binsar, Naini Tál
consimilis, *Don* ...	51	H.	1′—2′	Gr. Pr.	March ...	Kapkot, outer hills.
32. Spiranthes						
amœna, *Bieb.* ...	52	H	6″—9″	Pk.	August ...	Naini Tál ...
33 Zeuxine.						
sulcata, *Lindl.* ...	53	H.	4″	Pk.	February,	Kota Dún ...
34. Goodyera.						
marginata, *Lindl.* ...	54	H.	6″	Pk	August ...	Gágar, Kálimundi.
35. Cypripedium.						
cordigerum, *Don* ..	55	H.	1½′	Wh.	May ...	Pindar valley.

Plants--(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Woods ...	7,000	R.	...	.	
Open ...	5—7,000	R	..	..	
Do. ...	3—5,000	R.	...	...	
Do. ...	5,000	R.	...	..	
Open and woods	6—8,000	R.	...	..	
...	...	.	...	...	
Woods and open	11,000	R.	..	..	
Woods ...	7,000	R.	...	...	
...	7,000	R	...	...	
Woods ...	6,5—8,000	R	...	...	
Open ...	3—5,500	R.	..	...	
Do. ...	6—7,000	R	..	...	
Wet ...	1,500	R	...	...	
Open ...	7—8,500	R.	...	...	
Do. ...	7,000	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
CXIII.—IRIDEÆ.						
1 Iris.						
nepalensis, *Don*	1	H.	2	Bl.	April	Almora
Kumaonensis, *Wall.*,	2	H	6″	Bl.	June	Pindari, Níti,
sulcata, *Wall.*	3	H	1½″	Bl.	July	Pindar valley,
2 Pardanthus.						
chinensis, *Ker.*	...	H.	3′—4′	Sc.	June	Almora
CXIV.—AMARYLLIDEÆ.						
1. Curculigo.						
orchioides, *Gartn.*	1	H.	9″	Y.	July	Almora
gracilis, *Wall.*	2	H.	2′—3′	Y.	August	Bágesar
2. Hypoxis.						
minor, *Don*	1	H.	3″	Y.	July	Almora, Káthi,
CXV.—DIOSCOREÆ						
1. Dioscorea.						
deltoidea, *Wall.*	1	H. sc.	15′—20′	...	May	Naini Tál, Kapkot
bulbifer, *L.*	2	H. sc.	15′	..	July	Almora
glabra, *Roxb.*	3	H. sc	10′—20′	...	July	Bhábar, Bágesar
pentaphylla, *L.*	4	H. sc.	10′	...	July	Almora
sagittata, *Roxb.*	5	H. sc.	10′	...	July	Almora
quinata, *Wall*	6	H. sc	3′	...	August	Lohá-thal
dæmona, *Roxb.*	7	H. sc.	25′	...	July	Sarju river
CXVI.—SMILACEÆ.						
1 Smilax.						
elegans, *Wall.*	1	S. sc.	5′—10′	Pr.	May	Sámkhet, Naini Tál
sp (*Hook cat.* No 7),	2	S sc	10′—15′	Pr	May	Káthi Pass
vaginata, *Dene.*	3	S sc	2′	...	May	Naini Tál, Binsar
maculata, *Roxb.*	4	S. sc.	10′	...	May	Almora, &c.
sp ———	5	S sc	25′	..	July	Bágesar
ovalifolia, *Roxb.*	6,7	S. sc.	25′	...	March	Kota Dún

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himálaya.*		Tibet	Remarks.
		Rainy.	Dry.		
Cultivated	3,500	R.			
Open	11,5—15,500	.	D.	T.	
Do.	6,500	R	...	...	
Do.	5—6,000	R	...	...	
Do.	6,000	R	...	...	
Woods	3—4,000	R	...	...	
Open	5—7,000	R.	...	.	
Woods	3—7,500	R	...	...	
Open	5,500	R	..	.	
Woods	1—3,000	R	...	...	
Open	5,500	R.	...	...	
Do.	5—6,500	R.	...	...	
Do.	6,000	R.	...	...	
Woods	2,500	R.	...	...	
Open woods	5,5—7,500	R.	...	...	
Forest	8—9,000	R.	...	..	
Do.	7—8,000	R.	...	..	
Open	4—6,500	R.	...	...	
Forest	3—4,000	R.		...	
Do.	1—2,000	R	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant	Colour of flower.	Time of flowering.	Locality.
CXVII.—LILIACEÆ						
1. Lilium.						
giganteum, *Wall.* ...	...	H	6′	Wh.	June ...	Dwáli ...
Wallichianum, *Schultz.*	...	H.	5′	Wh.	August ...	Almora ...
oxypetalum, *Baker* ...	...	H.	9″—12″	Gr Y.	June ..	Pindari ...
nepalense, *Don* ...	...	H.	3′—4′	Wh.	June ...	Naini Tál ...
2 Fritillaria.						
cirrhosa, *Don* ...	...	H.	6″—12″	Gr Y	May ...	Champwa, Pindari.
macrophylla, *Don* ...	...	H.	2′—3′	Rose.	March ...	Almora ...
3 Tulipa.						
stellata, *Hook.* ...	...	H.	6″—18″	Wh	Feb. ...	Almora, &c. ...
4. Lloydia.						
serotina, *Reich.* ...	1, 2	H.	3″—6″	Wh.	May to July.	Pindari Patharkori, Bomprás, Rajhoti
5 Gagea						
lutea, *L.* ...	...	H.	4″	Y.	May ...	Pindari ...
6. Iphigenia.						
indica, *Kth.* ...	...	H.	9″	Pr.	June ...	Almora ...
7. Gloriosa.						
superba, *L.* ...	...	H.	4′—15′	Sc. Or.	August ...	Almora, Bhábar.
8. Allium.						
Govanianum, *Wall.* ...	1	H.	9″	Wh	June ...	Sing-jari ...
Wallichii, *Kth* ...	2	H.	.	Pk	June ...	China, Rálam,
victoriale, *L.* ...	3	H.	1′—2′	Wh	June ...	Binsar, Dudatoli.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet	Remarks.
		Rainy.	Dry.		
Woods	7—9,000	R.	...	...	
Open	4—6,000	R	...	...	
Do.	11—12,500	R.	...	...	=Fritillaria sp in Herb. S. & W.
Woods	7,000	R.	...	. .	
Open	11—12,000	R	...	..	= *Lilium* No. 2 in Herb S & W.
Do.	3, 5—5,000	R.	...	...	=*Lilium* No. 2 in Herb S. & W.
Fields	3—7,000	R.	...	...	
Open	11—15,000	R.	D.	T.	
Open	11—12,000	R	...	...	
Do.	1—6,000	R.	...	...	
Do.	1—6,000	R.	..	...	
Wet	11,000	R.	...	...	
Open	8—12,000	R.	...	...	
Woods	7—10,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
sp. (No. 13 *Hook cat.*),	4	H	2′	Wh.	June ...	Sing-jari ...
rubens, *Schræd.* ..	5	H.	9″	Pk.	August ...	Rálam ..
sp. (No. 15 *Hook cat.*),	6, 9	H.	9″—12″	R	June, July,	Rajhoti, Laptel, Tazang.
lineare, *L* ...	...	...	...	...	...	...
var junceum ...	7	H.	6″—8″	Pr.	August ...	Rákas Tál, ..
ellipticum, *Wall.* ...	8	H.	9″	Pk.	June ..	Jaliya khal, Milam.
schænoprasum, *L* ...	10	H.	6″	?	July ...	Plain of Tibet?
9. Urginea.						
indica, *Kth.* ...	...	H.	...	...	...	Plains ...
10. Asphodelus.						
fistulosus, *L.* ...	...	H.	...	...	January ...	Hardwár ...
11. Asparagus.						
ascendens, *Roxb.* ...	1	S.	6″	Wh	...	Outer hills ...
lævissimus, *Stend.* ...	2	S.	3′—4′	Wh.	July ...	Rámganga river
filicinus, *Ham.* ...	3	S	3′—4′	Wh.	June ...	Sing-jari, Námik.
12. Polyonatum.						
multiflorum, *All* ...	1	H.	2′—2-3	Wh.	April ...	Gágar Pass ...
roseum, *Led?* ...	4	H.	2½	W. V.	July ..	Bimkim ...
verticillatum, *All.* ...	2, 3, 6	H.	2′—3′	Wh.	April to June,	Naini Tál, Námik Kamni, Sing-jari.
sibiricum, *Red.* ...	5	H.	3′—4′	Wh.	May ...	Bágesar valley, &c.
13. Theropogon.						
pallidus, *Maxim.* ...	...	H.	2′	Wh.	May ...	Sámkhet ...
14. Tovaria.						
pallida, *Roxb.* ...	2	H.	2′—3′	Wh.	May ...	Dwáli ...
purpurea, *Wall.* ...	1	H.	1′—1½	Pr.	May ...	Mádhári Pass,

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	11,500	R	...	...	
Do ...	12,000	R.	...	...	
Do. ...	14—16,000	...	..	T	
...	...	..	...	..	
Do. ...	16 500	..	.	T.	
Do. ...	10—13,000	R	D.	T.	
Do. ...	15,500 ?	...	..	T.	
Fields ...	1,000	R.	...	...	=*Scilla* No 2 in Herb. S. and W.
Do. ...	1,000	R.	...	...	
Open ...	3—7,000	R.	...	...	
Do. ...	3—6,000	R.	...	...	
Woods ...	7—9,500	R.	...	...	
Do. ...	7—7,500	R.	...	..	
Do. ...	13,500	...	..	T.	
Do. ...	7—10,000	R.	...	...	
Open ...	4—8,000	R.	...	..	
On trees ...	6—7,500	R.	...	...	=*Chloopsis* No. 2 in Herb. S. & W.
Woods ...	8—9,000	R.	...	...	=*Smilacina* No 2 in Herb S. & W.
Do. ...	9—10,000	R.	...	...	=*Smilacina* No 1 in Herb. S. & W.

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
15 Clintonia.						
alpina, *Kth.* ...	...	H.	1½′	Wh.	June ...	Kulhára ...
16. Streptopus						
simplex, *Don* ..	...	H.	2′	...	...	Rár Pass ...
17. Ophiopogon.						
intermedius, *Don* ...	...	H.	1–1½′	Wh.	May ...	Naini Tál, Káthi.
18. Disporum.						
calcaratum, *Don*—var. Hamiltonianum,	1, 2	H.	2′	Gr, Y.	May ...	Káthi? Dwáli, Binsar.
pullum, *Salisb.*—var parviflorum ...	3	H.	2′	Gr, Y.	May ...	Káthi ...
19 Tofieldia.						
nepalensis, *Wall.* ...	1	H.	3″—4″	Wh	July .	Patharkori ...
sp. (No 2 *Hook cat.*),	2	H.	4″—6″	Wh.	July .	Rajhoti ...
20 Paris						
polyphylla, *Sm.* ...	1	H.	2′	Gr	May ...	Naini Tál ...
sp.—— ...	2	H.	1′	...	May ...	Námik .
21. Trillidium.						
Govanianum, *Kth.* ...	...	H.	6″—9″	...	May ...	Madhári Pass
CXVIII.—PONTEDERIACEÆ.						
1. Monochoria						
vaginalis, *Presl.* ...	...	H.	1½′	Bl.	July ...	Almora ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the area.	*Himálaya.*		Tibet	Remarks.
		Rainy.	Dry.		
Woods ...	10—11,000	R	...	...	
Open	11,000	R.	...	...	
Woods ...	7—8,000	R	...	..	
Do. ..	6, 5– 8,000	R	...	..	
Do. ..	8,000	R.	...	..	
Open ..	10—13,500	R	D.		
Do. ..	15,000	..	..	T.	
Woods ..	7—7,500	R.	...	...	
Do. ...	8,500	R.	...	...	
Do. .	9,600	R.	...	...	
Wet ...	1—4,000	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
CXIX.—COMMELYNACEÆ.						
1 **Commelyna.**						
sp.—— .	1, 4	H.	1′—1½′	*Bl*	August ..	Mohargári, Naini Tál.
bengalensis, *L.* ..	2	H	1′	Bl.	August ...	Almora ..
obliqua, *Lam* .	3	H	1′	Bl	August ..	Do ..
sp —— ..	5	H.	1½′	Bl.	August ..	Rámári ..
communis, *Kth.* .	6	H	1′	Bl	August ..	Almora ..
2. **Cyanotis.**						
barbata, *Kth.* ..	1	H.	3″—6″	Bl	August ...	Naini Tál, Jágesar.
cristata, *Kth.* ..	2	H.	9″	Bl.	August ...	Almora ? .
3. **Aneilema.**						
nudiflora, *Kth.* .	...	H.	6″	Bl	August	Almora
scapiflora, *Wight* .	...	H.	2′	Pk.	August ...	Jágesar, Naini Tál.
4. **Dithyrocarpus.**						
paniculatus, *Roxb.* .	...	H.	1′	Pk.	August ...	Near Almora .
5. **Streptolirion.**						
volubile, *Edgew* ..	...	H sc	...	Pk.	September,	Dhauli river ...
CXX.—JUNCEÆ.						
1. **Juncus.**						
triglumis, *L.* .	1	H.	3″	...	July ..	Rajhoti ..
sphacelatus, *Dcne.* ..	2	H.	2′	...	July ..	Laptel ..
sp —— .	3	H.	6″—9″	...	July .	Barjikáng Pass
sp —— ...	4	H.	2′	...	July ..	Milam, Rálam,
castaneus, *Sm.* ..	5	H	2′	...	July ...	Tola ..
glaucus, *Ehrh.* ..	6	H	2′—3′	...	June ..	Binsar, Naini Tál.
biglumis, *L.* ..	7	H.	2″	...	August ...	Barjikáng Pass.

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	1—6,000	R	.	...	
Do ...	1— 4,500	R	...	...	
Do. ..	4,000	R	.	...	
Do ...	4,500	R	...	...	
Do. ...	4,000	R.	..	...	
Do. ...	6—8,000	R	...	...	
Do. ...	1—5,000	R.	..	...	
Do. ...	1—5,000	R.	...	...	
Do. ...	5 6,500	R.	..	...	
By water ...	1—4,000	R.	..	...	
Open, on bushes,	6—7,000	...	D.	...	
Open, wet ...	15,000	...	...	T.	
Do. ..	15,000	.	...	T.	
Do. ...	14,500	R.	D	...	
Do. ...	12,000	R	D	...	
Do. ...	11,500	..	D.	.	
Do. ...	6—7,500	R.	...	..	
Do. ...	14,500	R.	D.	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower.	Time of flowering	Locality.
bufonius, *L* ...	8	H	9″	...	May ..	Háwalbágh ...
sp (No. 9 *Hook. cat*),	9, 11 13	H	3″—10″	...	May August.	Bindari Rajhoti, Barjikáng Pass
concinnus, *Don* .	10	H	15″	...	August ..	Jágesar, Naini Tál
sp (—No. 10 *Hook. cat*)	12	H	8″	...	August ...	Milam, Rálam,
2. Luzula						
plumosa, *Wall.*	1	H.	9″	Pk	May ...	Mádhári Pass,
campestris, *L.* ...	2	H.	3″	Pk.	May ..	Do .
spicata, *DC.* ...	3	H.	2″	Pk.	July ...	Bomprás ,,
CXXI.—AROIDEÆ.						
1. Arisæma						
costatum, *Mart.* ...	4	H.	1′—1½′	...	May .	Mádhári Pass,
speciosum, *Mart* .	5	H	1½′	...	May ...	Káthi ,,
consanguineum, *Schott.*	6	H.	2′—3′	...	June ..	Naini Tál ...
curvatum, *Roxb* ..	7, 9	H.	1½′—2′	...	June ..	Bampa, Jelam,
sp ——	8	H.	1′—2′	.	May .	Káthi .
Jacquemontii, *Bl.* .	11	H	2′	..	June ..	Naini Tál, China
sp (*Wall cat* 8920). .	12	H	2½′	..	July ..	Rálam, Rilkot,
erubescens, *Sch.* .	13	H.	2′—3′	.	May ..	Káthi ...
2 Sauromatum						
guttatum, *Sch.* ...	10	H	3′	..	July ...	Almora, outer hills.
3 Remusatia						
Hookeriana, *Sch.*	2	H.	3″	..	June ...	Káthi ..
vivipara, *Sch.* .	14	H.	1′—2′	...	September,	Bágesar, Bhim Tál
4 Colocasia.						
antiquorum, *Sch.* .	3	H.	1′—2′	...	September,	Almora, Sarju river

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya* Rainy.	*Himálaya* Dry.	Tibet.	Remarks.
Open, wet ...	4—6,000	R		...	
Do. ...	10,500 —15,000	R.	D	T.	
Do ...	6—9,000	R.	...	...	
Do. ...	11,500	R.	D.	..	
Open ...	10,000	R.	...	...	
Do ...	10,000	R.	.	...	
Do. ...	14,500	...	D.	...	
Forest ...	7—8,000	R.	...	...	
Open ...	6—7,500	R.	...	...	
Forest ...	6—7,500	R	..	...	
Open ...	6—11,000	R.	D.	...	
Open ...	6—7,500	R.	.	...	
Woods ...	8,000	R.	..	..	
Open ...	9—12,000	R	..	...	
Woods ...	6—7,500	R.	...	...	
In shade ...	3—5,000	R.	...	...	
On rocks ...	7,200	R.	...	...	
Woods ...	3—4,500	R.	...	...	
Cultivated ...	1—5,000	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
5. Scindapsus.						
decursiva, *Sch.* ...	1	H.	30′	..	...	Baisani ...
sp —— ...	3	H.	20′	...	...	Sarju river, outer hills.
6 Typhonium.						
diversifolium, *Wall.*	1	H.	6″	...	July ...	Binsar, near, Almora.
7. Gonatanthus.						
sarmentosus, *Klotsch* ?	15	H.	6″—9″	...	September,	Kálimat, Binsar.
CXXII.—TYPHACEÆ						
1 Typha.						
elephantina, *Roxb.* ...	...	...	8′—10′	...	...	Tarái ...
CXXIII.—LEMNACEÆ.						
1. Lemna						
polyrhiza, *L.* .	...	...	...	...	...	Almora, &c. ...
CXXIV.—NAIADEÆ.						
1. Triglochin.						
palustre, *L.* ...	1	H.	9″	G R.	July ...	Tisum, Rájhoti,
maritimum, *L.* ...	2	H.	6″	...	July ...	Rájhoti ...
2. Potamogeton.						
natans, *L.* ...	1	H.	9″	...	...	Náini Tál, &c.,
lucens, *L.* ..	2	H.	6′	...	...	Do. ...
rufescens, *Schrâd* .	3	H.	6″	..	...	Rájhoti ...
crispum, *L.* ..	4	H.	2′	..	...	Below Almora,
perfoliatum, *L.* ...	5	H.	2′	...	...	Náini Tál, Bhím Tál
sp.—— ...	6	H.	2′	...	...	Above Milam,
pectinatum, *L.* ...	7	H.	6′	...	...	Naini Tál ...
sp.—— ..	8	H.	1′	...	...	Rájhoti ...
sp.—— ...	9	H.	1′	...	...	Above Milam,

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
On trees ..	2—4,000	R.	...	..	
Do. ..	2—4,000	R.	...	...	
Shady banks ...	4—7,000	R.	...	...	
On trees, &c, ...	5 -8,000	R.	...	...	
Swamps ...	1,800	R.	...	..	
In water ...	4—6,000	R.	..	...	
Open., wet ...	15,000	...	...	T.	
Do. ...	15,000	...	...	T.	
In water ...	4—6.400	R.	...	...	
Do. ...	6,400	R	...	...	
Do. ...	*15,000*	..	...	T.	
Do ..	4,000	R.	...	...	
Do. ..	4—6,400	R.	...	...	
Do. ..	13,000	...	...	D.	
Do. ...	6,400	R.	...	...	
Do. ...	15,000	...	...	T.	
Do. ...	13,000	...	...	T.	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
CXXV.—ALISMACEÆ						
1. Alisma						
reniforme, *Don*	..	4	1½′	Wh.	June	Baijnáth
CXXVI.—ERIOCAULEÆ						
1 Eriocaulon						
oryzetorum, *Mart.*	1	H.	12″	Wh	July	Háwalbágh
luzulæfolium, *Mart.*	2, 5	H	4″	Wh.	July	Do
hexangulare, *L,*	3	H.	4″	Wh.	July	Do
(quinquangulare,)	4, 6	H	4″—6″	Wh	July	Do (& Mádhári P ? 10,000 ft).
sp —	7	H.	2″	Wh.	July	Háwalbágh
CXXVII.—CYPERACEÆ						
1. Carex.						
cruciata, *Nees.*	1	..	3′	...	July	Shaidevi
condensata, *Nees*	2	...	3′	.	July	Almora, Binsar, &c,
filicina, *Nees.*		.	.	...	..	..
var meiogyna	8	...	2′—3′	.	May	Káthi
foliosa, *Don*	4	.	2′—3′	.	May	Do, Binsar...
nubigena, *Don*	5	...	1′—1½′	...	August	Binsar Rálam river.
Wallichiana, *Presc*	6	..	1′—2′	...	March	Bhábar
ligulata, *Nees.*	7	...	2′	.	July	Shaidevi
cardiolepis, *Nees*	8	..	4″—12″	...	May	Námik, Pindari.
hæmatastoma, *Nees.*	9	...	...	...	?	?
fusiformis, *Nees.*	10	...	1½′	..	July	Binsar
psychrophila, *Nees.*	11	.	1½′	..	May	Dudutoli
orbicularis, *Boott*	12	.	4″—12″	..	August	Laptel
Moorcroftii, *Falc.*	13	..	6″—9″	...	August	Damchen, valleys of Tibet.
obscura, *Nees.*	14	...	1½—½	...	April	Rálam R.
setigera, *Don*	15	...	1′	...	April	Naini Tál
var. fasciculata	16	...	9″	..	May	Jagthána Pass,

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himalaya.*		Tibet.	Remarks
		Rainy.	Dry.		
Open, wet ...	3,500	R.	...	...	
Wet ...	1—4,000	R.	..	...	
Do ...	1—4,000	R.	...	...	
Do. ...	1—4,000	R.	...	...	
Do. .	1—4,000	R.	...	...	
Do. ...	1—4,000	R.	...	...	
Woods ...	6,000	R.	...	...	
Do. ...	5—7,500	R	...	. .	
...	...	...	...	...	
Open, near water.	7,500	R.	...	...	
Open, wet ...	7,200	R.	...	...	
Do. ...	75—10,500	R.	...	...	
Near water ...	1,500	R.	...	...	
Open ...	7,000	R.	...	...	
Do. ...	10—12,500	R.	...	...	
?	?	...	...	..	
Open . .	7,000	R.	...	...	
Do., wet ...	10,000	R.	...	...	
Do. ...	14—15,000	...	...	T.	
Do. ...	15—15,500	...	...	T.	
Do , wet ...	10,500	R.	...	...	
Do ...	6,500	R.	..	...	
Do. ...	8,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
supina, *Wall* ...	17	...	3"	..	June ...	Bagdwár ...
Stracheyi, *Boott.* ...	18	..	1'	..	May ..	Below Mádhári Pass
Esenbeckii, *Kth.* ..	19	...	6"—9"	...	June ...	Pathar-kori ...
gracilenta, *Boott* ...	20	.	4"—6"	...	May ...	Mádhári Pass,
Lehmanni, *Dreg*	21		6"—8"	...	August ...	Dung .
crostrata, *Boott.*	22	.	3"—8"	...	August .	Barjikáng Pass, Damchen
nivalis, *Boott* ...	23	..	1½	...	August ...	Barjikáng Pass, Damchen, valleys of Tibet.
cruenta, *Nees* ...	24	...	1'—1½'	...	August ...	Barjikáng Pass, Damchen.
var mutica ..	25	...	6"—12"	...	August ..	Damchen ...
coriophora, *Fisch* ...	26	...	8"	...	August ...	Balchha Pass...
2 Trilepis.						
Royleana, *Nees* .	...	...	6"	...	...	Hoti, Karnáli river
3 Elyna.						
schœnoides, *C. A. M.*	...	...	6"	...	...	?
4 Hypoporum						
pergracile, *Nees* ...	...	...	1'	...	...	Almora ...
5 Hypolytrum.						
argenteum, *Vahl.* ...	...	...	1'	...	...	Almora ...
6. Fimibristylis.						
chætorrhiza, *Nees.* ...	1	...	1½'	...	...	Almora ...
complanata, *Link.* ...	2	...	9"	..	...	Jágesar ...
pallescens, *Nees.* ...	3	...	6"—9"	...	...	Almora ...
communis, *Kth.* ...	4	...	2'	...	...	Binsar, Jágesar, Lohá-thal.
7. Isolepis.						
trifida, *Nees.* ...	1	...	6"—8"	...	...	Lohá-thal, above Jalat
setacea, *R. Br.* ...	2	...	6"	...	...	Near Milam.
barbata, *R. Br.* ...	3	..	4"	...	...	?

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open, wet	8,000	R	...	...	
Near water	8,000	R	. .	. .	
Open	11,000	R.	...	..	
Do, wet	10,000	R.	...	.	
Do	13,500	...	D	.	
Do.	14,5—15,500	R.	...	T.	
Do.	14,5—15,500	R		T	
Do	14,5—15,500	R	...	T.	
Do	15,000	...	D.	T.	
Near water	16,500	. .	. .	T	
Open, wet	15,500	...	...	T	
?	?	...	..	...	
Wet	4,000	R.	...	...	
Near water	4—5,000	R	...	...	=*Lipocarpha* in Herb S. & W.
Open	5,500	R	...	...	
Do.	7,500	R	...	...	
By water	4,000	R.	...	...	
Wet	6—7,500	R	...	...	
Do.	5—7,500	R.	...	...	
Do.	12,500	...	D.	...	
?	?	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower.	Time of flowering.	Locality.
8 Scirpus.						
mucronatus, *L.* ...	1	...	3′	...	...	Lohá-thal, Almora, &c.
sylvaticus, *L.* ...	2	...	...	...	...	?
lacustris, *L* ...	3	...	10′	...	...	Bhim Tál ...
9. Schœnus.						
compressus, *Panz.* ..	...	...	6″	...	..	Karnáli river.
10. Eleocharis.						
palustris? *R. Br.* ...	...	...	9″—12″	...	...	Jágesar ...
11. Eriophorum.						
comosum, *Wall.* ..	...	...	2′—3″	...	...	Bhábar, Almora, Bágesar, Ramganga river.
12 Cyperus						
angulatus, *Nees.* ...	1	..	4″	...	...	Lohá-thal ...
aristatus, *Rottb.* ..	2	...	...	...	...	?
pumilus, *L.* ...	3	.	4″—6″	...	...	Almora, ...
niveus, *Retz.* ...	4	...	6″—12″	...	...	Ditto, Naini Tál
Eragrostis, *Vahl.*	5	..	1′—1½′	...	...	Ditto, Sába ...
polystachyus, *Rottb.*...	6	...	1½′	...	...	Ditto, Lohá-thal
rotundus, *L.* ...	7	...	1½′	...	...	Ditto ..
exaltatus, *Ret* ...	8	...	3′—4′	...	...	Ditto, Kapkot,
corymbosus, *Rottb*	9	...	4′	...	...	Ditto
Iria, *L* ...	10	...	2′—3′	...	...	Ditto, Kosi river, Naini Tál.
pilosus? *Vahl.* ...	11	...	2′—3′	...	...	Almora ...
distans, *L* .	12	...	...	...	...	?
13 Kylingia						
gracilis, *Wall.* ..	1	..	1′—1½′	...	...	Shaidevi ...
monocephala, *L.* ...	2	...	4″	...	...	Jágesar ...
cylindrica, *Nees.* ...	3	...	4″	...	...	?

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Wet ...	3,5—6,000	R	...	...	
..	4,000	R.	..	...	
In water ...	4—4,400	R.	...	...	
Open ...	15—16,000	...	...	T.	
Wet ...	7,500	R	...	...	
Dry banks ...	4,500	R.	...	...	=*Trichophorum* No 1 & 2 in Herb. S. & W.
Wet ..	6,000	R.	...	...	
...	4—6,000?	R	...	...	
Wet ...	4,000	R.	...	...	
Open, dry ...	5—7,000	R.	...	...	
Wet ...	5—6,000	R.	...	...	
Do. ..	4—6,000	R	...	...	
Do. ...	4,000	R.	...	...	
Do. ...	3—4,000	R.	...	...	
Do. ...	4,000	R.	...	...	
Do. ...	4—6,000	R	...	...	
Do. ...	4,000	R.	...	...	
...	4,000?	R.	...	...	
Open ...	7,000	R.	...	...	
Do. ...	5—6,000	R.	...	..	
...	?	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
14. Mariscus.						
umbellatus, *Vahl.* ..	1	...	2′	...	...	Almora ...
paniceus, *Link* ...	2	...	1′	...	...	Do. ...
CXXVIII.—GRAMINEÆ.						
1 Oryza.						
sativa, *L.* ...	...	...	...	...	...	Almora, &c. ...
2 Zea.						
Mays, *L.* ...	...	...	...	...	...	Almora, &c ...
3 Coix.						
lachryma, *L.* ...	...	...	4′	...	...	Bágesar, Almora.
4 Alopecurus.						
fulvus, *Sm.* ...	...	...	1′	...	...	?
5. Phleum.						
alpinum, *L.* ..	1, 2	...	1½′	...	...	Rálam ...
6. Phalaris.						
minor, *Retz.* ...	...	...	...	...	...	Sirmoria ...
7. Hierochloa.						
laxa, *R. Br.* ...	...	...	2′	...	...	Pindari : above Milam.
8. Paspalum.						
scrobiculatum, *L.* ...	1	...	..	...	...	?
Royleanum, *Nees.* ...	...	...	...	...	...	?
filiculine, *Nees.* ...	...	...	...	...	...	Almora ...
9. Milium.						
*effusum, *L.* ...	...	...	...	...	...	Mádhári Pass,

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	5,500	R.	...	...	
Do. ...	5,500	R.	...	...	
Cultivated ...	1—6,000	R.	...	...	
Do. ...	1—7,000	R.	...	...	
Open, wet ...	1—5,000	R.	...	...	
Open ..	1—5,000	R.	...	...	
Do. ...	7—11,000	R.	...	...	
Do. ...	4,000	R	...	...	
...	12—13,000	R	D.	...	
Do. ...	1—5,500	R.	.	...	
Do. ...	5,500	R.	...	...	
Do. ...	5,500	R.	...	...	
Do. ...	8,500	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
10. Digitaria						
*sanguinalis ...	1	...	2′	...	...	Almora ...
*commutata, *Nees.* ...	2	...	...	...	...	Almora ...
*cruciata, *Nees.* ..	3	...	...	...	...	?
11. Panicum.						
*flavidum, *Retz.* ...	1	...	...	...	...	Somesar ...
*miliaceum, *L.* ...	2	...	2′—3′	...	...	Almora ...
*Helopus, *Trin.* ...	3	...	1′	...	...	Do. ...
*vestitum, *Nees.* ...	4	...	9′	...	...	Do ...
*psilopodium, *Trin.* ..	5	...	2′	...	...	Jagesar ...
*frumentaceum, *Roxb*	6	...	...	...	...	Almora ...
12 Urochloa.						
semialata, *Kth.* ..	...	...	...	...	...	Binsar ...
13. Thysanolæna.						
Agrostis, *Nees.* ..	...	...	0′—8′	...	...	Ramganga river, Kota river,
14. Isachne.						
albens, *Trin.* ...	1	...	1¼′	...	...	Girgaon ...
muricata, *Nees.* ...	2	...	1½′	...	...	Somesar, near Almora.
15. Oplismenus.						
Crus-Galli, *Kth.* ...	1, 2,		2′	...	...	Almora, Gori valley.
*undulatifolius, *R. & S.*,	3	...	1′	...	...	Jágesar ...
16. Pennisetum.						
*triflorum, *Nees,* ...	...	...	2′	...	...	Almora ...
sp.—— ...	...	...	1½	...	...	Jelam, Níti ...
17 Penicillaria.						
*spicata, *Lamk.* ...	...	...	...	...	...	Almora ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy	Dry.		
Open ...	1—5,500	R.	...	...	
Do. ...	5,500	R.	...	...	
...	5,500	R.	...	...	
Open ...	1—5,000	R.	...	...	
Cultivated ...	1—5,000	R.	...	...	
Open ...	5,500	R.	...	...	
...	5,500	R.	...	...	
.	1—6,000	R.	...	...	
Cultivated ...	1—6,500	R.	...	...	
Open ...	6,500	R.	...	...	=*Coridochloa* in Herb. S. & W.
Do. ...	2—5,000	R.	...	...	
Do. ...	6,000	R.	...	...	
Do. ...	4—5,000	R.	...	...	
Do. ...	1—6,000	R.	...	...	
Shade ...	6,000	B.	...	...	
Open ...	5,500	R	...	...	
Do. ...	9—11,000	R.	...	...	=*Gymnothrix* in Herb. S & W.
Do. ...	5,500	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower	Time of flowering.	Locality.
18. Setaria.						
glauca, *Beauv.* ...	1,	...	2′	...	...	Near Almora ...
verticillata, *Benth.* ...	2,	...	2′	...	...	Naini Tál ...
italica, *Kth.* ...	3,	...	3′	...	...	Almora ...
viridis, *Beauv.* ...	4,	...	2′	...	...	? ...
19 Piptatherum.						
soongaricum, ...	1,	...	1½′	..	...	Shelshel river,
æquiglume, *Munro*, ...	2,	...	...	...	...	? ...
20. Lasiagrostis.						
mongholica, *Trin.* ...	...	...	1½′	..	...	Shibchitam ...
21 Stipa.						
pallida, *Munro*	...	...	1½′	...	...	Plains of Tibet,
22 Aristida.						
cyanantha, *Nees.* ...	...	...	2′	...	...	Almora ...
23 Sporobolus.						
elongatus, *R Br* ...	...	...	...	...	...	Almora, Jágesar
24 Agrostis.						
alba, *L* ...	1,	..	...	...	...	?
Royleana, *Nees,* ...	2,	..	..	...	...	Almora ...
ciliata, *Nees.* ...	3, 4,	...	2′	...	...	Rálam river ... Barjikáng Pass,
Roylei, *Trin* ...	5,	...	..	...	...	Above Náraik,
25 Polypogon.						
monspeliense, L ...	1	...	...	...	...	Bhábar, below Almora,
Sp. (P fugax, *Nees*),	2	...	...	...	...	Almora ...
26 Calamagrostis.						
nepalensis, *Nees,* ...	...	...	3′	...	...	Above Jalut, Dwáli.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya.*		Tibet.	Remarks.
		Rainy	Dry.		
Open ...	1—4,000	R	...	...	
Do, ...	6,500	R	.	...	
Cultivated ...	1 - 6,500	R	. .	...	
Open ...	6,000?	R.	...	...	
Do ...	14,500	.	..	T.	
Do, ..	14,500	..	. .	T.	
Do. ...	14,300	.	. .	T.	
Do. ..	15,000	..	...	T	
Do. ..	4—5 000	R	. .	...	=*Chataria* in Herb S & W.
Wet ...	5—7,500	R.	. .	...	= *Vilfa diandra.* in Herb, S & W.
...	?	R	..	.	
Open ...	5,500	R.	. .	..	
Wet ...	{ 11,000 —1,41.500 }	R.	. .	...	
...	10,000	R.	...	...	
Water ...	1—4,500	R.	...	..	
Open ...	5,500	R	...	...	
Do. ...	7, 5—9,000	R.	..	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
27. Deyeuxia.						
compacta, *Munro, M S*	1	...	1″	...	...	Valleys of Tibet
scabrescens, *Munro, M S.*	2	...	2′	...	...	Pindari, Milam
28. Arundo.						
madagascariensis, *Kth.*	...	...	...	...	...	Almora, Banoth.
29 Phragmites.						
Roxburghii, *Steud* ...	...	...	10′	...	...	Bhím Tál, Bhábar.
30. Arundo,						
benghalensis, *Retz.* ...	...	...	8′	...	...	Kapkot, Jalat,
31. Cynodon.						
Dactylon, *Pers.* ..	...	...	1′	...	...	The plains, Sirmoria, Almora.
32 Eleusine						
corocana, *Pers.* ...	1	...	2′	...	...	Almora ..
*var. stricta ...	2	.	2′	...	...	Do. ..
indica, *Gaertn.* ...	3	...	1½′	...	...	Jalesar, Almora, below Jalat.
33. Deschampsia.						
cæspitosa, *Beauv.* ...	..	...	6″—18″	...	...	Laptel river, Balchha Pass
34 Trisetum.						
aureum, *Nees.* ...	1	..	1′—2′	...	...	Milam, Tola .
subspicatum, *Beauv.*	2, 4, 5	...	3″—4″	...	...	Balchha Pass, valleys of Tibet.
virescens, *Nees.* ...	3	..	2′	...	...	Mokargári ...
35 Avena.						
sativa, *L.* ...	...	...	..	...	...	Almora ..

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	15,000	...	...	T.	
Wet ...	11,500	R.	D.	...	
Open ...	1—5,000	R.	...	...	
Water ...	1—4,400	R.	...	...	
Open ...	1—5,000	R.	..	...	=*Amphidonax* in Herb. S & W.
Do. ...	1—5,500	R.	...	...	
Cultivated ...	1—5,500	R.	...	...	
Do. ...	4,000	R.	...	...	
Open ..	5—6,000	R.	...		
Do. ...	14—16,500	...	...	T.	
Do. ...	11—12,000	...	D.	...	
Open ...	12—16,500	R.	...	T.	
Woods ...	6,500	R.	...	...	
Fields ...	5,500	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
36. Danthonia.						
kashmiriana ...	1, 2	...	1'—2'	...	...	Milam, Rálam, Níti, near Tola.
37. Poa.						
tibetica, *Munro.* ...	1	...	1½'	...	...	Plains of Tibet
*pratensis, *L* ...	2	...	1½'	.	. .	Do. . .
*Royleana, *Nees.* ...	3	...	1'	...	. .	Kulhara . .
*bulbosa, *L.* ...	4	...	4"—6"	...	...	Topidhunga ...
*var, vivipara ..	5	...	6"—9"	...	...	Do. ...
*annua, *L* ...	6		6"	...	...	Kulhara ...
*flexuosa, *Wahl.* ..	7	..	6"	...	...	Pindari ..
var.—— .	8	...	1'	...	...	Milam, Jungbwatál.
sterilis, *Bieb.* ...	9	...	...	...	...	Barjikáng ...
*nemoralis, *L.* ...	10	...	...	...	..	Níti ...
*serotina, *Ehr,* ...	11	...	...	...	...	Dúgli ...
*alpina, *L.* ...	11	...	...	...	...	Do plains of Tibet.
nepalensis, *Wall.* ...	...	...	...	...	...	Binsar ...
38. Eragrostis.						
Brownei, *Nees.* ...	1, 2, 3	...	...	...	...	Sirmoria ...
elegantula, *Kth.* ..	4	. .	. .	...	..	? ...
verticillata, *Nees.* .	5	...	1¼'	...	...	Háwalbágh ...
amabilis, *W. & A.* ...	5	...	1'	...	...	Almora ...
bifaria, *W & A* ...	7	...	1'	...	...	Do. ...
*megastachya, *Link.*	8	...	2'	...	...	Do. . .
nigra, *Nees.* ...	9	..	2'—3'	...	...	Above Jalat, Kálimundi Pass.
39 Melica.						
micrantha, *Griesb.* var. inæqualis.	...	...	8'	...	...	Níti ...
40. Kæleria.						
cristata, *Pers.* ...	...	...	1¼'		...	Naini Tál, Káthi.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himálaya.* Rainy.	*Himálaya.* Dry.	Tibet.	Remarks.
Open ...	11—12,000	R.	D	...	
Do .	15,000	...	...	T.	
Do.	15,000	.	...	T.	
Do. ...	10,500	R.	.	...	
Do. ..	14,500	...	D	.	
Do. ..	14,500	...	D.	.	
Do ...	10,500	R.	...	..	
Do. ..	12,000	R	..	..	
Do. ...	12,—15,500	...	...	T.	
Do. ..	13,500	R	...	...	
Do. ...	12,000	...	D.	...	
Do. ...	10,500	R.	...	...	
Do. ...	10,—15,500	R	..	T.	
Do. ...	7,000	R.	...	...	
Do. ..	4,000	R	..	...	
..	4,000	R	...	...	
Open ...	4,000	R.	...	...	
Do ...	5,000	R.	oo	...	
Do. ...	5,000	R.	...	...	
Do. ..	5,500	R.	...	...	
Woods ...	7,500	R.	...	...	
Open ...	11,500	...	D.	...	
Do. ...	6—7,500	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower	Time of flowering.	Locality.
41. Dactylis						
glomerata, *L.* ..	...	...	3′	...	...	Naini Tál, Káthi, Jalat, Jhuni.
42 Tripogon						
filiformis, *Nees.* ..	1, 2	...	1′	...	...	Ditto, Thákil, above Jalat.
43. Festuca.						
*elatior, *L.* ...	3	...	...	...	...	Binsar ...
sp. —— ...	...	...	4′	...	...	Ditto, Káthi, &c
*pumila, *Vill.* ...	1	...	6″	...	...	Valleys of Tibet
sp. —— ...	2	...	9″	...	...	Ditto ditto, Chorhoti Pass.
sp —— ...	...	...	1½′ 2′	...	...	Plains of Tibet,
44. Bromus.						
giganteus, *L* ...	1	...	4′	...	...	Dwáli ...
confinis, *Nees.* ...	2	...	2½′	...	...	Rálam ...
arvensis, *L.* ...	3	...	1½′	...	...	Above Jhuni,
*tectorum, *L* ...	4	...	1′—1½′	...	...	Milam ...
45. Brachypodium.						
scaberrimum, *Nees.*	...	...	1′—1½′	...	...	China, Naini Tál.
46. Dendrocalamus.						
strictus, *Nees.* ..	...	...	20′—30′	...	...	Bhábar ...
47 Arundinaria.						
falcata, *Nees* ...	...	...	15′	...	...	Naini Tál, &c,
sp —— ...	...	...	20′	...	...	Ramni, Dudatoli

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himalaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	6—8,000	E.	...	...	
Rocks open ...	7—8,700	R.	...	...	
Woods ...	7,500	...	...	...	
Do. ...	7—8,000	R.	...	...	=*Schænodorus* No. 1 in Herb. S. & W.
Open ...	15,000	...	...	T.	
Do. ...	15—16,000	...	D.	T.	
Do. ...	15,000	...	...	T.	=*Schænodorus* No 2 in Herb. S. & W.
By water ...	8,000	R	...	...	
Open ...	12,000	R	...	...	
Do. ...	7,700	R.	..	...	
Do. ...	11,000	...	D.	...	
Do. ...	8,000	R.	...	...	
Open woods ...	1—2,500	R.	...	...	
Forest ...	5—7,000	R	..	...	=*Ludolfia* No. 1 in Herb S. & W.
Do ...	8—11,000	R.	...	...	=*Ludolfia* No. 2 in Herb. S. & W.

List of Kumaon

Name.	Herbarium number (*Strachey and Winterbottom*)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
48 Thamnocalamus.						
Falconeri, *Munro* ...	...	...	20′	...	...	Madhári Pass, Dugh.
spathiflorus, *Munro* .	...	...	30′	...	...	Ukhimath ...
49. Bambusa.						
Falconeri, *Munro*	2					
50 Lolium.						
*temulentum, *L.* ..	...	...	2′—3′	...	...	Sirmoria ..
51. Triticum.						
*vulgare, *Vill.* .	...	...	2′	.	..	Níti, &c ..
* var villosum ...	..	...	2–2½	...	...	Milam, &c. ...
longiaristatum ...	...	...	1½′—2′	...	...	Milam, Plain of Tibet
caninum, *L.* ...	...	...	2′	...	...	Almora ...
52. Agropyrum.						
semicostatum, *Nees,*	1,5	...	2′—3′	...	...	Almora, Milam, Karnáli river
sp —— ...	4	...	1½′	...	...	Almora ? ..
sp —— ..	7	..	1½′	...	...	Gothing ...
53. Elymus.						
*sibiricus, *L.* ..	1	...	2′	...	.	Plains of Tibet,
sp —— ...	2	...	2′—2½′	...	...	Milam, Pindari, Topidhunga
dasystachyus, *Trin.* .	3	...	3′	...	...	Laptel ..
54. Hordeum.						
pratense, *L.* ..	3	...	1½′—2′	...	...	Shib Milam .
*vulgare, *L.* ...	1, 2	..	2½′	...	...	Plains, Níti, Milam, Kyunlung.
55. Mnesithea.						
lævis, *Kth.* ...	...	...	2′	...	...	?

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry		
Forest ...	7—8,500	R.	...	...	=*Bambusa* No. 1 in Herb. S. & W.
Open woods ...	4,000	R	...	...	
Corn fields ..	4,000	R	...	...	
Cultivated ..	1—11,500	R	D	...	
Do. ..	11,500	.	D.	..	
Open ..	12,5—16,000	R	...	T	=*Agropyrum* Nos 2 & 3 in Herb. S & W.
Do. ..	5,500	R.	...	...	=*Agropyrum* No. 6 in Herb. S. & W.
Do. ...	5—15,000	R	D.	T	
Do .	5,500	R	.	..	
Do. ..	12,000	...	D	...	
Do. ..	15,000	..	...	T.	
Do. ...	12—15,000	R.	D.	...	
Do ..	14,500	...	...	T.	
Do ...	14,500	.	...	T.	
Cultivated ...	1—14,000	R	D.	T.	
Open ...	1—4,000	R.	D.	...	=*Hæmarthria* in Herb. S. & W.

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower	Time of flowering.	Locality.
56. Rottboellia.						
exaltata, *L.* ...	...	...	10′	...	...	Háwalbágh ...
57 Manisuris.						
granularis, *Swartz* ...	...	...	...	...	...	Almora ...
58. Perotis.						
latifolia, *Ait.* ...	...	...	1′—2′	...	...	Below Almora,
59. Eriochrysis.						
Narenga, *Nees* ...	...	...	6′	...	...	Sarju valley ...
60. Saccharum.						
Sara, *Roxb.* ...	...	...	3′—4′	...	...	?
officinarum, *L.* ..	...	...	5′—8′	...	...	The plains, Almora.
61. Imperata						
Kœnigii, *Beauv.* ..	1, 2	..	3′—6′	...	...	Bhábar, Almora, Shaidevi, Sarju valley.
62. Pogonatherum,						
polystachyum, *R.&S*	...	...	1′	...	...	Sarju river near Almora
63. Erianthus						
velutinus, *Munro* ...	...	...	3′	...	...	Almora near Jalat.
rufipilus, *Griseb.* ..	2	...	3′—4′	...	...	Naini Tál, Gágar pass
Jacquemontii, *Munro,*	3	...	3′—4′	...	...	Above Kota, Rámganga river.
*rufus, *Nees* ...	4	...	2′	...	...	Below Jalat ...
sp.—— ...	5	...	3′	...	...	Almora, above Jalat.
64. Eulalia.						
nepalensis, *Trin.* ...	...	...	2′	...	...	Naini Tál ...

Plants—(continued).

Conditions of soil, &c	Elevation in feet above the sea	*Himá-laya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open	1—4,500	R.	...	...	
Do.	1—4,500	R	...	...	
Do.	4,500	R.	...	...	
Do.	1—3,500	R.	...	...	=*Saccharum* No. 1 in Herb. S. & W.
?	?	R.	...	...	=*Erianthus* No. 1 in Herb. S. & W.
Cultivated	1—5,000	R.	...	...	
Open	1—7,200	R.	...	...	
Do.	1—4,000	R.	...	...	
Do.	5—6,000	R.	...	...	=*Pollinia* No. 1 in Herb. S. & W.
Woods	7,500	R.	...	...	
Open	2,5—5,500	R	...	...	
Do.	5,000	R	...	...	
Do.	5—7,000	R.	...	...	
Woods	7,500	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower.	Time of flowering.	Locality.
65. Pollinia						
Lehmanni, *Nees*	2	...	2′—3′	...	...	Almora, near Jalat.
66. Anthistiria						
anathera, *Nees*	1	..	2′—3′	...	...	Almora, below Jalat
ciliata, *L.f.*	3	...	3′	...	...	Above Jalat
67. Androscepia						
gigantea, *Brogn*	...	...	15′	...	...	Kota, Almora,
68. Apluda.						
aristata, *L.*	1	...	2′—3′	...	...	Almora
var.——	2	..	2′—3′	...	...	Do
69 Batrarotherum						
lanceolatum, *Nees*	1	...	1′	...	...	Almora
submuticum, *Nees* }	2	...	1′	...	...	Do.
plumbeum }						
molle, *Nees*	3	...	1′	...	...	Below Almora,
70. Hologamium						
nervosum, *Nees*	...	..	3′—4′	...	...	Below Almora,
71. Gymnandropogon.						
annulatum	...	...	2′—3′	...	...	Kálidhungi
triste	...	...	4′	...	...	Above Jalat
72. Anatherum.						
muricatum, *Beauv.*	...	...	6′—7′	...	...	Bhábar
73. Sorghum.						
muticum, *Nees*	1	...	4′	...	...	Bágesar
halepense, *Pers.*	2	...	...	...	..	Bhábar
vulgare, *Pers.*	3	...	...	...	...	Almora
74 Heteropogon.						
contortus, *Nees*	1	...	2′	...	...	Almora
melanocarpon	2	...	4′	...	...	Do.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himalaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	5,500	R.	..	...	
Do ...	4–5,500	R	...	...	
Do. ...	7,500	R.	...	...	
Do. ...	7,500	R.	..	...	=*Anthestiria* No 2 in Herb. S. & W.
Do ...	1–5,500	R	...	...	
Do ..	5,500	R.	...	...	
Do ...	4,500	R.	...	...	
Do. ...	4,500	R	...	...	
Do. ...	4,000	R.	...	...	
Do ...	4,500	R	...	..	
Do. ..	1,000	R.	...	...	=*Lepeocercis* in Herb S & W.
Do. ...	7,500	R	...	...	=*Andropogon* No. 1. in Herb. S. & W.
Do. ...	1–2,000	R	...	...	
Do ...	3,000	R.	...	...	
Do ...	1–3,000	R.	...	...	
Cultivated .	5,000	R	...	...	
Open ...	1–6,000	R	...	...	
Do. ...	5,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
75. Andropogon.						
pachnodes, *Trin.* ...	3	...	5′	...	...	Adhbadri, &c,
*Iwarancusa, *Roxb.*	7	...	...	...	...	Bhábar and low valleys.
76 Cymbopogon.						
distans ..	...	...	3′—4′	...	...	Naini Tál ...
Gidarba, *Ham.* ...	.	...	3′—4′	...	...	Kálimath, Naini Tál
laniger	...	...	4′—5′	...	...	Kálapathar ...
77. Chrysopogon.						
montanus, *Trin.* ...	7	...	3′	...	...	Almora? ..
serrulatus, *Trin.* ...	1	...	2—3	...	...	Almora ..
cœrulens *Nees* ..	2	...	2′	...	...	Do. ..
Gryllus, *Trin.* ...	3, 4, 5,	...	3′—4′	...	...	China, Binsar, Páton.
villosus, *Nees* .	6	...	1½′	...	...	Below Jalat ..
78. Garnotia.						
polygonoides, *Wight*,	...	...	...	...	...	Near Jalat ..
79. Ischæmum.						
speciosum, *Nees* ...	...	...	3′	...	...	Almora ..
var. —— ..	...	...	2′—2½′	...	...	Naini Tál ...
80 Spodiopogon						
angustifolius, *Nees* ..	...	...	2′	...	...	Naini Tál? ..

I find the following note by Mr. C B Clarke at the end of his MS. list
unequal. I have turned over the bundles marked "Ind Or" or "Cosmopoli
have been worked by Gen. Munro, some are passing through his hands, some not
large residuary bundles marked "spp" and in these sometimes the Strachey
many other cases where the Strach and Winterb plant is found in a particular
since the ticket was put on, and it may have been hastily sorted into the bundle
very partially renamed—*Triticum* seems not to have been touched since the list
Even where the genera have been thoroughly worked and written up, it would
part of *Bambusa*, sp 2., into *Bambusa*, part into *Thamnocalamus*, but it would
were not cut by Strachey from the same plant.

Kew, 11*th November*, 1879.

The names which are not included in Mr. Clarke's list are marked with an aste-
mentioned, he did not come across in the Kew Herbarium.

Plants—(continued).

Condition of soil, &c.	Elevation in feet above the sea.	*Himá-laya.* Rainy.	Dry.	Tibet.	Remarks.
Open ...	2—4,500	R	...	...	
Do. ..	1—4 000	R.	...	...	
Do ...	4—8,000	R.	...	...	=*Andropogon* No. 2 in Herb S. & W.
Do. ...	6—8,000	R.	...	...	=*Andropogon* No. 4 in Herb S. & W.
Do. ...	2,500	R	...	...	=*Andropogon* No. 5 in Herb . S & W.
Do. ...	5,500	R.	...	...	=*Andropogon* No. 6 in Herb. S. & W.
Do ..	5,300	R	...	...	
Do ..	5,500	R.	..	...	
Do. ...	5—8,700	R.	...	...	
Do. ...	5,000	R.	...	...	
Do. ...	7 000	R	...	...	=Nov. Genus near *Polypogon* in Herb. S. & W.
Do. ...	5—8,000	R.	...	...	
Do. ..	5,000 ?	R	...	...	
Do. ...	6,000	R	..	...	

of grasses of the S and W Herbarium " The above reduction of the Grasses is
tan," not any others (in general) The grasses are in various states; some
yet touched, or at all events not yet written up. To many of the genera are
and Winterbottom tickets remain In this case they cannot be reduced, but in
bundle (with a name outside) there is no sign that the plant has been examined
merely as being "*inter affines*" From these various causes the grasses are only
was made. Why I found all the *Eragrostis* and very little of the *Poa* I cannot guess
take a long time to verify the species carefully; thus Gen Munro has sorted
nevertheless take me some time to assure myself that the two pieces of No 2

C B. CLARKE.

risk. Amongst these are no doubt several, such as from the various causes above

J. F. D.

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
CXXX—FILICES *						
1. Gleichenia.						
linearis, *C. B. Clarke,*	...	...	2′—3′	...	...	Rámganga valley, &c.
2. Woodsia.						
elongata, *Hook.* ...	1	...	6″—12″	...	...	Kálimundi, Bagdwár.
lanosa, *Hk. & Baker*...	2	...	2″	...	...	Pindari ...
sp.—— ...	3	...	3″—4″	...	...	Pindar and above Námik.
3. Dicksonia.						
appendiculata, *Wall.*	...	...	3′	...	...	Gori valley, Karim.
4. Hymenophyllum.						
exsertum, *Wall.* ..	1	...	4″	...	...	Madhári Pass,
polyanthus, *Swartz.* ..	2	...	2′—3′	...	...	Dwáli, Námik,
5. Davallia.						
polypodioides, *Don* ...	1	...	2′	...	...	Rámganga river.
chinensis, *Swartz.* ...	2	...	1′—2′	...	...	Bágesar ...
membranulosa, *Wall.*	3	...	9″	...	...	Mohurgári ...
pulchra, *Don* ..	4	...	1½′	...	...	Rámganga river, Binsar.
immersa, *Wall.* ...	5	...	6″—9″	...	...	Binsar ...
6. Cystopteris.						
fragilis, *Bernh.* ...	...	...	6″—9″	...	...	Topidhunga, Sangchá.
7. Adiantum.						
Capillus-Veneris, *L.* ...	1	...	1′	...	...	Jagthána ...
venustum, *Don* ...	2	...	1½′	...	...	Naini Tál, &c.,
pedatum, *L.* ...	3	...	1′	...	...	Dwáli, Singjari.
caudatum, *L.* ...	4	...	1′—2′	...	...	Bágesar, Pharka.
var rhizophorum ..	6	...	6″—12″	...	...	Jagthána, Binsar.
lunulatum, *Burm.* ...	5	...	1′—1½′	...	...	Sarju river, Bhim-Tál

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* These have been arranged as far as possible in accordance with Mr. C. B. Clarke's

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	3—6,000	R	...	...	
Forest ...	8,000	R.	...	...	
Open ...	12,000	R.	...	...	
Do. ...	11—12,000	R.	...	...	
Shade ...	5—7,000	R.	...	...	
Wet rocks ..	8,000	R.	...	...	
Trees and rocks,	8—9,000	R.	...	...	
Banks ...	2,500	R.	...	...	
Do. ...	3,000	R.	...	...	
Do. ...	6,500	R.	...	...	
Trees ..	4,5—7,500	R.	...	...	
Rocks ...	6—7,000	R.	...	...	
Do. ...	14—15,000	...	D.	T.	
Rocks near water	3—5,000	R.	...	...	
Forest ...	6—8,000	R.	...	...	
Do. ...	9—10,000	R	..	...	
Banks ...	3—6,500	R.	...	...	
Do. ...	4—8,000	R.	...	...	
Do. ...	3—4,500	R.	...	...	

recently published "Review of the Ferns of Northern India."

J. F. D.

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
8. Cheilanthes.						
farinosa, *Kaulf.*	1	...	1′—1½′	...	...	Bágesar, Almora, &c.
sp ——	2	...	1′	...	...	Pharka ...
sp. ——	3	...	1″	...	...	Mohargári ...
9. Onychium.						
japonicum, *Kunze*	2	...	2′	...	...	Naini Tál &c.,
var. multisecta	1	...	1½′	...	...	Do. ...
10. Cryptogramme.						
crispa, *R Br.*	1 & 2	...	3″—4″	...	...	Champwa, Tola, Rálam,
11 Pellæa.						
calomelanos, *Link.*	...	...	6″	...	...	Below Almora.
12. Pteris.						
pellucida, *Presl.*	...	...	...	...	...	...
var. stenophylla	1	...	1′—1½′	...	...	Bágesar ...
cretica, *L.*	2	...	2′	...	...	Naini Tál, Káthi,
longifolia, *L.*	3	...	3′	...	...	Sarju river ...
quadriaurita, *Retz.*	4, 5, 6	...	1′—3′	...	...	Bágesar, Jalat, Pharka, Barmdeo.
sp. ——	...	...	3′—4′	...	...	Káthi, &c. ...
Wallichiana, *Agardh*	...	...	4′—6′	...	...	Bagdwár ...
13. Woodwardia						
radicans, *Smith*	...	...	6′	...	...	Pyúra, &c. ...
14. Asplenium						
Nidus, *L.*	1	...	1½′—2′	...	...	Rámganga river.
ensiforme, *Wall.*	2	...	1½′	...	...	Káthi ...
alternans *Wall.*	3	...	4″—6″	...	...	Bágesar, Almora
septentrionale, *L.*	4	...	4″	...	...	Milam, Níti ...
viride, *Huds.*	5	.	3″—4″	...	...	Pindari ..
Trichomanes, *L.*	6	...	3″—4″	...	...	Milam ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himalaya*		Tibet.	Remarks.
		Rainy.	Dry.		
Rocks	3—7,500	R	...	...	
Do.	6,500	R.	...	...	
Banks	4 500	R.	..	...	
Forest	6—8,000	R.	...	...	
Do	6—8,000	R	...	...	
On rocks	10—12,000	R	...	...	
Dry rocks	4,000	R.	..	...	= *Allosorus* No. 1 in Herb. S. & W.
...	...	...	...	...	
Forest	3,000	R.	...	...	
Do.	3—7,000	R	...	.	
Do.	2—4,000	R	...	...	
...	...	...	..	...	
Open	7—8,000	R	..	..	= *Allosorus* No 2 in Herb. S & W.
Forest	8,000	R.	...	...	= *Campteria* in Herb. S & W.
Wet banks	4—6,500	R	...	...	
On trees	2,500	R.	...	...	
Do	8,000	R	..	...	
Banks	3—6,000	R.	...	...	
Rocks	11,—12,000	...	D.	...	
Do.	12,000	R.	...	...	
Do.	11,500	...	D.	...	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
falcatum, *Sw.*	...	...	1½′—2′	...	...	Dwáli, Naini Tál.
sp ——	7	...	4″—6″	...	...	Jágesar ...
laciniatum, *Don*	8	...	10″	...	...	Ják, upper Tola.
varians, *Hk. & Grev*	9	...	..	...	...	Dwáli ...
sp ——	...	...	2′	...	...	Naini Tál ...
Filix-fœmina, *Bernh.*,	...	...	1′—2′	...	...	Do. ...
var. pectinata	...	...	2½′	...	...	?
sp.——	...	...	1½′—2′	...	...	Jágesar ...
esculentum, *Presl.*	...	...	3′—4′	...	...	?
sp ——	...	...	3′—4′	...	...	Gori valley ...
japonicum, *Thunb.*	...	...	1½′	...	...	?
sp ——	...	...	2′	...	...	Káthi ...
15. Aspidium.						
auriculatum, *Sw.*	...	...	...	...	...	...
var. lenta	...	...	1½′—2′	...	...	Rámganga river.
,, cæspitosa	...	...	1′	...	...	Sarju river ..
,, marginata	...	...	1½′—2′	...	...	Dwáli ...
sp.——	...	...	1′	...	...	Káthi ...
ilicifolium, *Don*	...	...	6″—9″	...	...	Mádhári Pass,
aculeatum, *Sw*	...	...	..	...	...	...
var rufo-barbata	...	...	3′	...	...	Binsar ...
sp.——	...	...	6″—12″	...	...	Dwáli, Rálam, Tola
Prescottianum, *Wall.*,	...	...	1½′	...	...	Rálam, Milam,
aculeatum, *Sw.*	...	...	...	...	...	..
var. setosa	...	...	3′—4′	...	...	Káthi ...
angulare, *Willd.* ?	...	...	3′	...	...	Naini Tál, Karim
var. ?——	...	...	2′	...	...	Kaphini ...
sp.——	...	...	2′	...	...	?
16. Nephrodium.						
parasiticum, *C. B. Clarke*?	...	...	...	...	...	?
var multijuga	...	...	2′—2½′	...	...	Karim ...
sp.——	...	...	...	...	...	?
sp.——	...	...	2′	...	...	?

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea	*Himálaya.*		Tibet.	Remarks.
		Rainy	Dry.		
Forest	7—8,500	R.	...	...	= *Cyrtomium* in Herb S. & W.
Banks	6,000	R.	..	...	named "*plebeium?*" and "*ruta, L?*" in original, probably = *A. varians.*
Rocks	5-6,000	R.	..	...	
Do.	8,500	R.	...	...	
Forest	7,000	R.	...	...	= *Athyrium* No 1 in Herb. S & W.
Do	7,000	R.	...	..	= *Athyrium* Nos. 2 & 4 in Herb. S. & W
...	...	R.	...	..	= *Athyrium* No 5 in Herb S. & W.
Forest	6,000	R	...	...	= *Athyrium* No 3 do.
...	...	R	...	...	= *Diplazium* No 1 do.
Open	8,000	R.	...	...	= *Diplazium* No 2 do.
...	..	R.	...	...	= *Diplazium* No 3 do
Forest	7,800	R.	...	...	= *Diplazium* No 4 do.
...	...	..	...	...	
Forest	2,000	R	...	...	= *Polystichum* No. 1 in Herb. S. & W.
Rocks	4,500	R	...	...	= Do. No. 2 do.
Forest	9,000	R	...	...	= Do. No. 3 do.
Do.	7,000	R	...	..	= Do. No. 4 do.
Do.	9,000	R.	...	...	= Do. No. 5 do.
...	...	...	...	...	= Do. No. 6 do.
Do.	6,5—7,500	R	..	..	= Do. No. 8 do.
Wet rocks	8—12,000	R	D	...	= Do. No. 9 do.
Open	11—12,000	R.	D	...	= Do. No 10 do.
...	...	..	...	...	
Forest	7,700	R.	...	...	= Do. No. 7 do Not in Clarke's review of N. Indian Ferns.
Do.	6—7,000	R.	...	...	= Do. No. 11 in Herb. S. & W.
Open	10,000	R.	...	...	= *Nephrodium* No. 1 in Herb. S. & W.
...	?	R	...	...	
...	...	R	...	...	= *Lastrea* No. 2 in Herb. S. & W.
Open	6,500	R	...	...	Do. No 1 do.
...	...	R	...	...	Do. No 3 do.
...	...	R	...	...	= Do. No. 4 do

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
Filix-mas, *Rich.*	...	...	...	...	...	...
var. patentissima ..	...	...	2′—3′	...	...	Kálimundi, Dudatoli.
var.—— ..	...	...	2′—3′	...	...	Milam ...
Brunonianum, *Hook*,	...	...	1½′	...	...	Rálam ...
var.—— ..	...	...	3′	...	..	Rálam, Sagtiadeo.
cochleatum, *Don* ..	...	...	2′—3′	...	...	Sarju valley, Dargara, Thal.
crenatum, *C.B. Clarke*,	...	...	2′—3′	...	...	Sarju valley ..
sp.—— ..	..	...	...	...	...	?
sp —— ..	...	...	2′—3′	...	...	Kálimundi ..
sp ——	...	...	1½′	...	..	?
polymorphum, *Hk & Baker*	...	...	2′—3′	...	...	Rámganga river.
cicutarium, *Hk. and Baker.*	...	...	...	...	...	...
var. coadunata ...	...	...	3′	...	...	Sarju river ...
17. Nephrolepis.						
cordifolia, *Hk. and Baker.*	...	...	2′—2½′	...	...	Near Bágesar ..
18. Oleandra.						
Wallichii, *Presl.* ...	...	...	1½′—2′	...	...	Mohargári, Binsár.
19. Polypodium						
erubescens, *Wall.* ...	1	...	3′	...	...	Rámganga river.
sp —— ..	2	...	1′—2′	...	...	?
sp.—— ..	3	..	4″—6″	...	...	Kálimundi ..
sp —— ...	4	...	3′	...	...	?
argutum, *Wall.* ..	...	...	1′—2′	...	...	Binsar ...
sp —— ...	...	...	1′—1½	...	...	Jágesar ..
lachnopus, *Wall.* ..	...	...	1′—2′	...	...	Naini Tál, Mohargári.
amœnum, *Wall.* ...	...	...	1′—1½′	...	...	Káthi ..
proliferum, *Roxb.* ...	...	...	2′—3′	..	..	Bhábar, &c. ...
lineatum, *Colebr.* ..	...	...	2′—3′	...	...	Bágesar, Pharka ?

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya*		Tibet.	Remarks.
		Rainy.	Dry		
...	...	..	...	...	
Forest ...	8,000	R	...	...	=*Lastrea* No. 5 in Herb. S. & W.
Open ...	11,500	...	D.	...	= Do. No. 6 do.
Do. ...	12,000	R.	...	...	= Do. No. 7 do.
Do. ...	11—12,500	R	...	...	= Do. No. 8 do.
Open banks and forest.	4—8,000	R.	...	...	= Do. Nos. 9 & 12 do.
Forest ..	3—4,000	R.	...	...	= Do No 10 do.
...	...	R.	...	...	= Do. No. 11 do.
Forest ...	8,000	R.	...	...	.. Do. No 13 do.
...	.	.	...	...	= Do. No 14 do.
Forest ...	2,600	R	...	..	=*Aspidium* in Herb. S & W.
...	...	...	..	...	
Forest ...	3—4,500	R.	...	...	=*Sagenia* in Herb. S & W.
Do. ...	3,000	R.	...	...	
Trees & banks,	6, 5—8,000	R.	...	...	
Forest ...	2,5—6,000	R.	...	...	
...	...	R	...	...	
Forest ...	8,500	R.	...	...	name *P. pendulum* in Herb S. & W
...	...	R.	...	...	named *P. angulosum* Lab in Herb. S & W.
Trees ...	7,000	R	...	...	=*marginaria* No. 1 in Herb. S. & W.
Do. ...	6,000	R	...	...	= Do. No 2 do.
Forest ...	6—7,000	R.	...	...	= Do. No. 3 do.
Banks ...	7,500	R.	...	...	= Do. No. 4 do.
Forest ...	1—2,000	R.	...	...	=*Goniopteris* in Herb. S. & W.
Trees ...	3,5,—6,000	R.	...	...	=*Nephrodium* No. 2 in Herb. S. & W.

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
membranaceum, *Don*,	...	...	3'	...	...	Below Naini Tál.
hastatum, *Thunb.*	...	...	...	...	...	...
var oxyloba	...	...	1'	..	...	Binsar
juglandifolium, *Don*,	...	...	2'—3'	...	...	Sarju river, Jágesar.
ebenipes, *Hook.*	...	...	1'—1½'	...	...	Binsar, Kálimundi.
sp.——	...	...	6"—9"	...	...	Binsar
sp.——	...	...	9"	..	...	Ditto.
sp.——	...	.	6"—8"	...	...	Do, Kálimundi,
propinquum, *Wall.*	...	...	1'—1½'	...	...	Binsar Rámári,
Wightianum, *Wall.*	...	...	9"—12"	...	...	Jagthana
lineare, *Thunb.*	...	...	1'—1½'	...	...	Naini Tál, &c,
sp.——	...	...	4"	...	...	Pathar-kori,
Stewartii, *C. B Clarke.*	...	...	1'—1½'	...	...	Binsar
sp.——	...	...	6"	...	...	Bágesar, Ják Pass
sp.——	...	...	1'	...	...	Rámári, Bágesar
flocculosum, *Don*	...	...	1½'—2'	...	...	Bágesar
adnascens, *Sw.*	...	...	3"—4"	...	.	?
20. Gymnogramma.						
vestita, *Hook.*	...	...	9"	...	...	Chína
flavescens, *Presl.*	...	...	9"—12"	...	...	Suring
sp.——	...	...	9"	...	...	Mohargári
sp.——	...	...	3'	...	...	Rámganga river.
Totta, *Schlecht.*	...	...	1'	...	...	Jágesar
sp.——	...	...	6"	...	...	?
21. Meniscium.						
sp.——	...	...	1½'	...	...	Bágesar valley,
22. Vittaria.						
elongata, *Sw.*	...	...	1'—1½'	...	...	Káthi, Sarju valley.

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Trees ...	4—6,500	R	...	...	=*Phymatodes* No. 1 in Herb. S. & W.
...	...	...	...	..	
Forest ...	6—7,000	R	...	.	= „ No. 2 do.
Do. ...	4,5—7,000	R	...	...	= „ No. 3 do.
On trees ...	7—9,000	R	...	...	= „ No. 4 do.
Do ...	7,500	R	...	...	= „ No. 5 do.
Do. ...	7,500	R	..	...	= „ No. 6 do.
Do. ...	7—8,000	R	...	...	= „ No. 7 do.
Do ...	4,5—7,000	R	..	...	= „ No 8 do.
Do. ...	5,000	R	..	.	= „ No 9 do.
Do. ...	6,5 8,000	R.	..	..	= „ No. 10 do
Open ...	10,500	R.	...	...	= „ No 11 do.
On trees ...	7,000	...	..	..	=*Pleopeltis* in Herb. S & W.
Do. ..	3—6,000	R.	..	..	=*Niphobolus* No. 1 in Herb. S. & W.
Do. ..	3,5—6,500	R.	...	...	= „ No. 2 do.
Do. ...	3,500	R	...	..	= „ No. 3 do.
...	...	R.	...	...	= „ No. 4 do.
On rocks ...	7—8,000	R	..	...	=*Notholæna* in Herb. S. & W.
Forest ...	4,000	R	..	..	=*Loxogramme* No 1 in Herb S. & W.
Do. ...	4,000	R.	...	...	= „ No 2 do.
Do. ...	2,5—8,000	R	...	...	named *G caudata* in Herb. S. & W.
On rocks ...	...	..	...	...	=*Grammitis* No. 1 in Herb. S. & W.
...	?	R.	...	...	= „ No. 2 do.
Forest ...	3,500	R.	...	...	
Trees ...	4,8—8,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
23. Osmunda.						
regalis, *L.* ...	1	...	2′	...	...	?
Claytoniana, *L.* ...	2	...	2′—3′	...	...	Above Námik, Rogila.
24. Lygodium.						
japonicum, *Sw.* ...	1 & 2	...	4′—5′	...	...	Bágesar, Bhábar
25. Botrychium.						
virginianum, *Sw.* ...	1	...	2″—3″	...	...	Almora ...
Lunaria, *Sw.* ..	2	...	1′—1½′	...	...	Tola ...
CXXXI.—MARSILIACEÆ.						
1 Azolla.						
pinnata, *Ham.* ..	...	...	...	...	...	Satráli valley, Almora
CXXXII.—LYCOPODIACEÆ.						
1. Psilotum.						
triquetrum, *Sw.* ...	...	...	6″	...	...	Gagás river ...
2. Lycopodium.						
Hamiltonii, *Spreng* ...	1	...	9″—12″	...	...	Sarju & Ramganga valleys
setaceum, *Ham.* ...	2½	..	9″—12″	...	...	Sarju valley, Jagthána
var. subulifolia ...	2	...	9″—12″	...	...	Do
clavatum, *L.* ...	3	...	3′—6′	...	...	Mádhári Pass, Dwáli.
3. Selaginella.						
caulescens, *Spring* ..	4	...	6″	...	...	Near Bágesar ..
sp.—— ...	5	...	2″	...	...	Deopryág
sp.—— ...	6	...	2″	.	...	Rinde river ...
radicata, *Spring.* ...	7	...	6″	...	...	Bágesar ..
integerrima, *Spring* ...	8	...	6″	...	...	Naini Tál, Tapuban.
semicordata, *Wall* ...	9	...	9″	...	...	Naini Tál ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
...	9,000?	R	..	...	
Open ..	8—10,000	R.	...	...	
On bushes, scandent.	1—4,500	R.	...	...	
Open ..	5—7,000	R	..	...	
Do. ...	12,000	R	D.	..	
On water ...	1—5,500	R.	...	...	
...	...	...	...	...	
On trees ...	4—5,000	R.	...	..	
Do. ...	4—5,000	R.	...	...	
Do. ..	4—5,000	R.	...	...	
Woods & open...	8—10,000	R	...	...	
Shady banks ...	3,000	R.	...	...	
River banks ..	2,500	R.	...	...	
On rocks ...	7,000	R.	...	...	
On banks ...	3,000	R.	...	...	
Open rocks ...	7—8,000	R.	...	...	
Damp woods ...	4—7,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
CXXXIII.—EQUISETACEÆ.						
1. Equisetum.						
arvense, *L.*	1, 3	...	6"—18"	...	...	Pindari, Rimkim
palustre, *L.*	..	...	...	...	...	...
var.——	2	..	6"—12"	...	...	Below Almora, Naini Tál.
debile, *Roxb.*	4, 5	...	4'	...	...	Bhábar, Naini Tál, Páton.
CXXXIV.—MUSCI.						
1. Braunia.						
sp——	1	...	...	...	...	Rúr pass
2. Anœctangium.						
æstivum	...	...	...	...	...	...
var. ?——	2	...	...	...	...	Devi-dhura
var. ?——	3	...	...	...	...	Dwáli
curvirostrum, *H & T.*	4	...	...	...	...	Dwáli ?
var.——	5	...	...	...	...	?
var ——	6	...	...	...	...	Below Jalat
involutum, *Hook.*	7	...	...	...	...	?
4. Neissia.						
serratula, *Bry.*	8	...	...	...	...	Above Námik,
5. Rhabdoweissia.						
fugax, *Bry.*	9	...	...	...	...	Champwa
6. Symblepharis.						
sp.——	10	...	...	...	...	Dwáli
7. Distichum.						
inclinatum, *Bry.*	11	...	...	...	...	Ráj-hoti
8. Desmatodon.						
Laureri, *Bry.*	12	...	...	...	...	?

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himalaya*		Tibet.	Remarks.
		Rainy.	Dry.		
Open, wet ...	11—13,500	R	...	T.	
...	..	..	...	...	
Wet places ...	4–7,000	R	...	...	
Open wet ...	1–6,000	R.	...	...	
Open ground ...	10,000	R.	...	...	
...	...	..	.	...	
Trees, &c., in forest.	7,000	R.	...	...	
...	8,600	R.	...	...	
..	8,500	R	...	...	
?	?	R	...	...	
...	5,000	R.	...	..	
?	?	R.	...	...	
...	9,000	R	...	...	
...	9,000	R.	...	...	
...	9,000	...	...	...	
Open wet ground.	15,000	...	...	T.	=*Didymodon inclinatum*, Hk. & T.
?	?	R.	...	...	=*Tortula bryoides*, Hk.

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
9. Tortula.						
sp ——	13	...	...	...	...	Dwáli
fallax, *Sw.*	.	...	...	...	...	...
var ——	14	...	. .	...	...	Do
unguiculata, *Hk. § T.*	15	...	...	...	...	?
10. Dicranum.						
sp.——	16	...	...	...	...	Champwa
11. Didymodon.						
cylindricus, *Bry.*	...	...	...	...	...	...
var ——	17	..	...	...	...	?
Tortula *Harv* ?	18	...	...	...	...	Dwáli
12. Campylopus.						
sp ——	19	...	...	...	...	Devi-dhúra
13. Fissidens.						
bryoides, *Hedw.*	20	...	...	...	...	Devi-dhúra
taxifolius, *Hedw.*	...	...	...	...	...	..
var ——	21	...	...	..	...	Do.
nobilis, *Griff.*	22	...	...	...	...	Pharka
14. Atrichum.						
crispum, *Wils.*	23	...	...	...	...	Bagdwár
15. Pogonatum.						
cirrhatum, *Sw.*	24	...	...	...	...	Sarju valley
urnigerum, *Bry.*	..	...	...	...	...	...
var. crassum	25	...	...	...	...	Bagdwár, Sarju valley.
microstomum, *Hook.*	26	...	...	...	...	Dwáli
16. Eucalypta.						
sp.——	27	...	...	...	...	?
17. Orthodon.						
serratus, *Schw.*	28	...	...	...	...	?

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya.*		Tibet.	*Remarks.*
		Rainy.	Dry.		
Banks & trees,	9,000	R.	..	...	
...	...	..	...	...	
...	8,500	R.	...	...	
?	?	R	...	...	
...	9,000	R.	...	...	
...	?	R	...	...	
?	...	...	...	...	
Banks & trees,	9,000	R	...	...	= *Weissia tenuirostris*, Hk. and T.
Banks ...	7,000	R.	...	...	
...	7,000	R.	.	...	
...	...	...	...	...	
...	7,000	R.	...	...	
...	6,500	R.	...	...	
...	8,000	R.	...	...	= *Polytrichum*, Hook. & T.
...	3,500	R.	...	...	
...	...	...	...	...	
...	3,5—9,000	R.	...	...	
...	8,000	R.	...	...	
...	?	R.	...	...	
...	?	R.	...	...	= *Octoblepharum serratum*,

Name.	*Herbarium* number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
18. Dissodon.						
sp.——	20	...	...	...	...	Champwa
19. Ptychomitrium.						
polyphyllum, *Bry.*	30	...	...	...	...	Dwáli
20. Schistidium.						
apocarpum, *Bry.*	...	...	...	...	...	...
var.——	31	...	...	...	...	Do.
21 Racomitrium.						
sp.——	32	...	...	...	...	Káthi
22. Mielichhoferia.						
sp.——	33	...	...	...	...	Pindari
23. Brachymenium.						
nepalense, *Hook.*	...	...	...	...	...	...
var.——	34	...	...	...	...	Dwáli
24. Bryum.						
elongatum, *Hk. & T.*	35	...	...	...	...	Do.
sp.——	36	...	...	...	...	?
sp.——	37	...	...	...	...	Jágesar
sp.——	38	...	...	...	...	Do.
Diwalli ? *Bry.*	39	...	...	...	...	Bagdwár
turbinatum ? *Bry.*	40	...	...	...	...	?
latifolium ? *Bry.*	41	...	...	...	...	?
sp ——	42	...	...	...	...	Barjikáng Pass.
versicolor, *Bry.*	...	...	...	...	...	...
var.——	43	...	...	...	...	Sába
giganteum, *Hook.*	44	...	...	...	...	Near Káthi
sp.——	45	...	...	...	...	Jágesar

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the area.	*Himálaya.*		Tibet.	Remarks.
		Rainy	Dry.		
Banks & trees,	9,000	R	...	...	
...	9,000	R	...	...	= *Trichostomum polphyllum*, Hk. and T.
		R	...	...	
...	9,000	...	...	...	= *Grimmia*, Hk. and T.
...	7,500	R.	...	...	= *Trichostomum*, Hook. and T.
Open ground,	11,000	R	...	..	
...	...	..	...	...	
...	9,000	R.	...	...	
...	8,500	R	...	...	
...	?	R.	...	...	
Banks ...	7,500	R	...	...	
...	7,500	R.	...	...	
...	9,000	R	...	...	
Open ground ...	14,000	...	...	T.	
Do. ...	15,000	...	.	T.	
Do. ...	14,500	R.	...	...	
	...	...	...	...	
...					
Wet banks and rocks.	9,000	R.	...	...	
Banks & trees.	8,000	R.	...	...	
...	7,000	R	..	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant	Colour of flower.	Time of flowering.	Locality.
25 Mnium.						
rhyncophorum, *Harv.*,	46	...	...	...	...	Káthi ...
sp.—— ...	47	...	...	...	...	? ...
sp —— ...	48	...	...	...	...	Káthi, Jalat,
26. Funaria.						
hygrometrica, *Hedw.*	...	...	...	...	...	...
var.—— ...	49	...	...	...	...	Kapkot ...
var.—— ...	50	...	...	...	...	Jágesar ...
27. Orthotrichum.						
sp.—— ...	51	...	...	...	...	Dwáli ...
28 Bartramea.						
patens, *Schw.* ...	...	...	...	...	...	...
var.—— ...	52	...	...	...	...	Champwa ...
sp —— ..	53	...	...	...	...	Do ...
falcata, *Hook.* ..	54	...	...	...	...	Kálimundi ...
var.—— ...	55	...	...	...	...	Gágar Pass ...
29. Leucodon.						
sp.—— ...	56	...	...	...	...	Dwáli, near Jalat.
30. Leptodon.						
sp.—— ...	57	...	...	...	...	Jagesar ...
31. Pterogonium.						
cæspitosum, *Wils* ...	58	...	...	...	...	Bagdwár ...
32. Neckera.						
sp —— ...	59	...	...	...	...	Sarju valley ...
squarrosa, *Hook.* ...	60	...	...	...	...	Jalat ...
crispatula, *Hook.* ...	61	...	...	...	...	Above Jalat ...
pennata, *Hedw.* ...	62	...	...	...	...	? ...
dendroides, *Hook.* ..	..	...	...	...	...	...
var.—— ...	63	...	...	...	...	Káthi ...
sp.—— ..	64	...	...	...	...	Do ...
acuminata? *Hook* ..	65	...	...	...	...	? ...
blanda? *Harv.* ...	66	...	...	...	...	Bágesar valley,
Griffithiana, *Schw.* ...	67	...	...	...	...	Dwáli ;
Julacea, *Harv* ...	68	...	...	...	...	Jágesar ...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy	Dry.		
...	7,000	R.	...	...	
?	?	R.	...	...	
...	7,000	R.	...	...	
...	...	...	...	...	
Banks ...	3,500	R.	...	...	
...	6,000	R.	...	...	
Trees ...	9,000	R.	...	...	
...	...	..	...	...	
Banks & trees,	9,000	R.	...	...	
...	9,000	R.	...	...	
...	8,000	R.	...	...	
Banks wet ...	7,000	R.	...	...	
Banks & trees,	5—8,500	R.	...	...	= *Sclerodontium secundum*, Harv.
...	6,000	R.	...	...	
...	9,000	R.	...	...	
Banks ...	3,500	R	...	...	
...	5,000	R	...	...	
...	7,500	R	..	...	
...	?	R	...	...	
...	...	..	...	...	
...	6,800	R.	...	...	
...	7,000	R	...	...	
...	?	R.	...	...	
...	3,500	R.	...	...	
...	8,500	R.	...	...	= *N. aurea*, Griff.
...	6,000	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom)	Habit of growth.	Height of plant.	Colour of flower	Time of flowering.	Locality
33. Cylindrothecium.						
sp.——	69	...	...	...	...	Bágesar valley,
34 Anmodon?						
sp ——	70	...	...	...	...	Káthi ...
sp.——	71	...	...	...	...	? ...
35 Pilotrichum						
sp ——	72	...	...	...	...	? ..
36. Isothecium.						
sp.——	73	...	...	...	...	? ..
37. Pylaisxa.						
polyanthos, *Bry.*	...	...	...	...	...	...
var.——	74	...	...	...	...	Jágesar ..
38. Hypnum.						
sp.——	75	...	...	...	...	Sarju valley ...
sp.——	76	...	...	...	...	Do. ...
confertum, *Dicks.*	...	...	..	...	...	...
var. —	77	...	...	...	...	? ...
plumosum? *Hook.*	78	...	...	...	...	Káthi ...
var.——	79	...	...	...	...	Mádhári Pass,
sp ——	80	...	...	...	...	Káthi ...
sp.——	81	...	...	...	...	Do. ...
salebrosum, *Hedw.*	82	...	...	...	...	Do. ...
sp ——	83	...	...	...	...	Sarju valley & Káthi.
sp.——	84	...	.	...	...	Sámkhet ...
fluviatile, *Sw.*	..	...	...	...	...	...
var.——	85	...	...	...	...	Sába ...
Wallichii, *Hook.*	86	...	...	...	...	Pharka ...
sp.——	87	...	...	...	...	Sarju valley ...
sp ——	88	...	...	...	...	Dwáli ...
sp.——	89	...	...	...	...	Sarju valley ...
macrocarpum, *Schw*,	...	..	...	...	...	...
var?——	90	...	...	...	...	Námik & Jalat,
proliferum, *L.*	91	...	...	...	...	Káthi, Naini Tál.
recognitum, *Hedw.*	92	...	...	...	...	Káthi

Plants—(continued).

Conditions of soils &c.	Elevation in feet above the sea.	*Himá-laya.*		Tibet.	Remarks
		Rainy.	Dry.		
...	3,500	R.	...	...	= *Neckera myura*, Hook.
Banks & trees,	7,000	R.	...	...	
?	?	R.	...	...	= *Neckera minor*? Hedw.
?	?	R.	...	...	
?	?	R	...	...	
...	...	R.	...	...	
...	6,000	R.	...	...	= *Leskea polyanthos*, Hook. and T.
Banks ...	3,500	R.	...	...	= *Leskea* sp ?
...	3,500	R.	...	...	= *Leskea acuminata* ? Hedw.
...	...	...	...	...	
Banks & trees,	?	R.	...	...	
...	7,000	R.	...	...	
...	8,000	R.	...	...	
...	7,000	R.	...	...	
...	7,000	R.	...	...	
...	7,000	R.	...	...	
...	3,5—7,000	R.	...	...	
In water ...	5,500	R	...	...	
...	...	...	...	...	
Wet banks ...	9,000	R.	...	...	
Do. ...	6,500	R.	...	...	
Banks ...	3,500	R.	...	...	
Banks & trees,	8,500	R	...	...	
...	3,500	R	...	...	
...	...	...	...	...	
...	7—9,000	R.	...	...	= *H. Strongylum*, Taylor.
...	6,500	R.	...	...	
...	6,500	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
commutatum, *Hedw.*,	...	...	...	...	...	...
var. ? ——	93	...	...	...	...	Ráj-hoti
Palustre, *L*	...	...	...	...	...	Bagdwár
var, subsphærocarpum.	94	...	...	...	...	...
sp. ——	95	...	...	...	...	Sarju valley
sp. ——	96	...	...	...	...	?
filicinum, *L.*	97	...	...	...	...	Gágar Pass
39. Leptohymenium						
microphyllum, *Schw.*,	98	...	...	...	...	Káthi
tenue, *Schw.*	99	...	...	...	...	?
40. Dicranodontium.						
longirostrum, *Bry.*	100	...	...	...	...	?
41. Hookeria.						
sp ——	101	...	...	...	...	Dwáli
42. Hypopterygium.						
sp. ——	102	...	...	...	...	Pharka
HEPATICÆ.						
1. Riccia.						
sp. ——	1	...	...	...	...	Sámkhet
sp ——	2	...	...	...	...	Do
sp. ——	3	...	...	...	...	Do.
2. Marchantia.						
sp. ——	1	...	...	...	...	?
sp ——	2	...	...	...	...	?
sp. ——	3	...	...	...	...	Near Jalat
sp ——	4	...	...	...	...	Do.
sp. ——	5	...	...	...	...	Sarju river
sp ——	6	...	...	...	...	?
sp. ——	7	...	...	...	...	Sarju river
sp. ——	8	...	...	...	...	Máson
sp. ——	9	...	...	...	...	Sarju river

Plants—(continued)

Conditions of soil, &c	Elevation in feet above the sea	*Himálaya.* Rainy	*Himálaya.* Dry.	Tibet.	Remarks
...	..	..	...	...	
Open wet ground	15 000	R.	..	...	
...	...	...	...	...	
...	9,000	R	...	...	
Banks ...	4,000	R.	...	...	
...	?	R	..	...	
Wet banks ...	7,000	R	...	...	
Banks & trees,	7,000	R.	...	...	
...	?	R	...	...	= *Neckera tenuis*, Hook.
...	?	R.	...	...	= *Didymodon*, Schw.
...	8,500	R	...	...	
...	6,500	R.	..	.	= *Hypnum laricinum*, Hook. var?
In water ...	6,000	R.	...	...	
Do. .	6,000	R.	.	..	
Do. ...	6,000	R.	...	...	
? ...	?	R.	...	.	
? ...	?	R	..	...	
Damp earth ...	5,000	R	...	...	
Do. ...	5 000	R.	...	...	
Do ...	3,000	R.	..	...	
? ...	?	R.	...	...	
Do. ...	3,500	R	...	...	
Do. ..	5,000	R.	...	...	
Do. ...	3,500	R.	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant.	Colour of flower.	Time of flowering.	Locality.
3. Jungermannia						
sp.— ...	1	...	...	...	...	Champwa ...
sp.— ...	2	...	...	...	...	Námik ..
sp.— ...	3	...	...	...	...	Dwáli ...
sp.— ...	4	...	...	...	...	Do. ..
sp.— ...	5	...	..	...	...	Do. ...
sp.— ...	6	...	...	...	...	Do. ...
CHARACEÆ.						
1. Chara.						
verticillata ...	...	...	...	...	...	Sariya Tál, &c,
2. Nitella.						
sp.— ...	...	...	...	...	...	Naini Tál ...
LICHENES.						
1. Colloma.						
saturninum, *Ach.* ...	1	...	...	...	...	Mádhári Pass,
nigrescens, *Ach* ...	2	...	...	...	...	Chína ...
tremelloides, *Ach.* ..	3	...	...	...	...	Do. ...
2. Umbilicaria.						
depressa, *Schrad* ...	...	...	...	...	...	Pindari ...
3. Lecidea.						
glacialis ? *Fries.* ...	1	...	...	...	...	Shelong ...
geographica, *Ach.* ...	2	..	...	...	...	Malchak Pass,
armeniaca, *Ach* ..	3	...	..	...	...	Shelong ...
sabuletorum, *Fries.* ...	..	...	...	...	...	...
var. coniops ...	4	..	...	...	...	Do. ...
4. Biatora.						
himalayana, *Bab.* ...	...	...	...	...	...	Gori river ...
5 Cladonia.						
pyxidata, *Fries.* ...	1	...	...	...	...	Pindari
vermicularis, *Ach.* ...	...	...	...	...	...	...
var. taurica ...	2	...	...	...	...	Bomprás
perfoliata ...	3	...	...	...	...	...

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himálaya.*		Tibet.	Remarks.
		Rainy.	Dry.		
Open ...	10,000	R.	...	...	
Banks in forest,	8,000	R.	...	...	
Do. ...	8,500	R.	...	...	
Do ...	8,500	R.	...	...	
Do. ...	8 500	R	...	...	
Do. ...	8,500	R.	...	...	
In water ...	5—6,000	R.	...	...	
...	6,500	R.	...	...	
On trees ...	8,200	R.	...	...	
...	8,700	R.	...	...	
...	8,700	R.	...	...	
Earth ..	12,000	R.	...	...	
Rocks ...	13,000	...	D.	...	
...	16,000	...	D.	...	
...	13,000	...	D.	...	
...	...	...	..	...	
...	13,000	...	D.	...	
...	4,700	R.	...	...	
...	12,000	R.	...	...	
...	...	...	...	...	
...	16,000	...	D.	...	
...	...	...	...	...	

List of Kumaon

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth.	Height of plant	Colour of flower	Time of flowering	Locality.
6. Stereocaulon.						
tomentosum, *Fries.*	1	...	...	...	...	Gori river
corallinum, *Schr.*	2	..	...	..	...	Pindari
ramulosum, *Ach.*	.	...	...	. .	...	
var. strictum.	3	...	. .	...	...	Sagtia-Deo Pass, Mádhári Pass.
7. Urceolaria.						
calcarea	. .	...	...	...	...	Shelong
8 Parmelia						
melanaspis, *Wahl.*	1	...	...	...	...	Shelong
pulverulenta, *Ach.*	...	...	...	...	...	...
var ——	2	...	...	..	...	Gori river
elegans, *Ach.*	3	...	...	...	...	Shelong
oreina, *Ach.*	4	...	...	...	...	Do
vitellina ? *Ach*	5	...	...	...	...	Do.
calcarea ? *Fries.*	6	...	...	...	...	Do
scruposa ? *Ach*	7	...	...	...	...	Do.
chrysoleuca, *Ach.*	8	...	...	...	...	Do.
saxicola, *Ach.*	9	...	...	. .	...	Do
cœsia, *Ach.*	10	...	...	...	...	Do.
stellaris, *Ach*	11	...	...	...	...	Do
speciosa, *Ach.*	12	...	..	...	...	Gori river, Chína
lævigata, *Ach.*	13	...	...	...	...	Chína
perlata, *Ach.*	15	...	...	...	...	Karim Pass
var saccatiloba	14	...	. .	...	...	China
perforata, *Ach.*	16	...	...	...	...	Do.
tiliacea, *Ach.*	17	...	...	...	...	Do.
scortea, *Ach.*	18	...	...	...	...	Madhári Pass,
caperata, *Ach*	19	...	...	...	...	Chína
leucomela, *Ach.*	20	...	...	...	...	Do
cirrhata, *Fries.*	21	...	...	...	...	Do.
9. Sticta.						
pulmonacea, *Ach.*	...	...	...	...	...	...
var hypomela	1	...	...	...	...	Chína
retigera, *Ach*	2	...	...	...	...	Dúgli
herbacea, *Del.*	3	...	...	...	...	Karim and Káthi Passes, Chína
10. Pettidea.						
horizontalis, *Ach.*	1	...	...	...	...	Above Dwáli...
canina, *Ach.*	2	...	...	...	...	Chínar Dwáli,

Plants—(continued).

Conditions of soil, &c.	Elevation in feet above the sea.	*Himá-laya.*		Tibet	Remarks.
		Rainy.	Dry		
...	4,700	R.	...	...	
Earth ...	12,000	R.	...	...	
...	..		..	...	
Rocks ...	8—11,500	R.	..	...	
...	13,000	...	D.	...	
...	13,000	...	D.	...	
...			...	...	
...	4,700	R	..	...	
...	13,000	..	D	...	
...	13,000	..	D	...	
...	13,000	.	D.	...	
...	13,000	. .	D	...	
...	13,000	...	D.	...	
...	13,000	...	D.	...	
...	13,000	...	D.	...	
...	13,000	...	D.	...	
...	13,000	...	D.	...	
Rocks and trees,	4, 7—8,700	R.	...	...	
On trees ..	8,700	R.	...	...	
...	7,500	R.	...	...	
On trees ..	8,700	R	...	...	
...	8,700	R.	...	...	
...	8,700	R.	...	...	
...	8,200	R.	...	...	
...	8,700	R.	...	...	
...	8,700	R.	...	...	
...	8,700	R	...	...	
...	..	...	...	...	
...	8,700	R.	...	...	
...	10,500	R	...	...	
...	7, 5—9,000	R.	...	...	
...	9,000	R.	...	...	
...	8—9,000	R.	...	...	

Name.	Herbarium number (Strachey and Winterbottom).	Habit of growth	Height of plant.	Colour of flower.	Time of flowering.	Locality.
11. Solorina.						
saccata, *Ach.*	...	...	...	...	...	Káthi Pass
12. Cetraria.						
Stracheyi, *Bab.*	1	...	...	...	...	Near Káthi
ambigua, *Bab.*	2	...	...	...	...	Bomprás
13. Ramalina.						
farinacea ? *Ach.*	...	...	...	...	...	Pindari
14 Evernia.						
Stracheyi, *Bab.*	...	...	...	...	...	Pindari, Bomprás.
15. Usnea.						
himalayana, *Bab.*	1	...	...	...	...	Binsar
longissima, *Ach.*	2	...	...	...	...	China
ceratina, *Ach*	3	...	...	...	...	Do
sp.?——	...	...	...	...	...	Do.
sp.?——	...	...	...	...	...	Hot valleys

NOTE.—The whole of this chapter has been edited and prepared by Mr. F. nished by General R. Strachey. My work has been confined to seeing that the proofs.—E. T. A.

Plants—(concluded).

Conditions of soil, &c	Elevation in feet above the sea	*Himálaya.* Rainy	*Himálaya.* Dry.	Tibet.	Remarks.
...	8,000	R.	...	...	
...	7,200	R.		...	
Stones ...	16,000	...	D	...	
Do ...	11,500	R	...	...	
Do. ...	11,5—16,000	R.	D.	...	
Trees ...	7,000	R.	...	...	
...	8,700	R.	...	...	
...	8,700	R.	...	...	
...	8,700	R	...	...	
On oberonia ...	2,000	R.	...	...	

Duthie, Superintendent of the Botanical Gardens, Sahâranpur, from the list fur-
corrections made in the first proofs by Mr. Duthie were carried out in the second

CHAPTER IX.

ECONOMIC BOTANY.

CONTENTS.

Arrangement of the subject. Food of the people. Analysis of the food-grains. Watson's formula. Cultivated food-grains. Cereals. Pulses. Amaranths. Polygonaceæ. Cultivated vegetables. Gourds. Vegetables. Condiments and spices. Greens. Fruits, cultivated and wild. Uncultivated products used as food. Drugs. Narcotics and spirits. Oil-seeds. Dyes and tans. Gums and Gum-resins. Fibres. Woods.

Arrangement of the subject.

THE economic botany of the Himálayan districts of these provinces, actual and potential, opens out such a wide field for investigation that it would be impossible to do more than review the information that we possess. The materials are to be found scattered over numerous memoirs, articles, reports, and notes, and are as practically inaccessible to the general public as if they had never been collected. The form of this chapter will, therefore, be more that of a suggestive classified list than of a treatise, which would, in the first place, be more than could be usefully prepared by one person; and, in the second place, will come more fitly into the general review of the economic products that is about to be undertaken by the Department of Agriculture in these provinces.[1] For the more orderly arrangement of our subject, we shall divide the useful products of the vegetable kingdom into the following classes:—

I.—Vegetable substances used as food by men and animals.

a. Cultivated food-grains.
b. Cultivated vegetables.
c. Spices and condiments.
d. Greens.
e. Fruits, cultivated and wild.
f. Uncultivated products used as food.

II.—Vegetable substances used in pharmacy.

a. Drugs.
b. Narcotics and spirits.

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[1] Progress has been made in this direction by the publication of my "Notes on the Economic Products of the North-Western Provinces." Part I, on 'Gums and gum-resins;' Part II., on 'Economic Mineralogy;' Part III., issued by the Department of Agriculture, contains, 'Tans and Dyes;' Part IV., 'Cultivated food-grains', Part V., 'Gourds: vegetables condiments and uncultivated products used as food.' The remainder are under preparation and will comprise 'Drugs,' 'Fibres,' 'Woods, and 'Narcotics.'

III.—Vegetable substances used in manufactures.

a. Oil-seeds.
b. Tans and dyes.
c. Gums and gum-resins.
d. Fibres.
e. Woods.

IV.—Special subjects.

a. Forest history.
b. Tea cultivation.
c. Rhea experiments.
d Sericulture.
e. Miscellaneous.

I.—VEGETABLE SUBSTANCES USED AS FOOD BY MEN AND ANIMALS.

Food of the people.

The population of the Himálayan districts is essentially Hindu, and consequently the vegetable kingdom affords most of the substances used as food by the people. Few of the hill-men, even amongst those who have had much communication with the plains, have any prejudice in regard to eating animal food. The majority partake of the flesh of kids, short-tailed sheep, and young male buffaloes at festivals and marriages, and whenever sacrifices are offered to the consort of Siva. With but few exceptions all eat the flesh of deer, pheasants, and partridges, but not of jungle fowl; whilst in Garhwál, all, including Brahmans, eat the flesh of the wild pig. The servile classes (Doms, &c.) eat meat of all kinds whenever they can get it, even of animals killed by wild beasts or which have died from disease, and in their habits differ little from the Chamárs of the plains. Uncultivated products are used as food chiefly by the inhabitants of the jungly tract lying along the foot of the hills and along the banks of the Káli, and, in times of scarcity, by the people of the upper Pattis. At all times, however, the young leaves of nettles, of several species of ferns, sorrel, and the like, are used as a spinach by all classes. An examination of the list of cultivated products used as food will show that the greater portion belong to the great natural orders *Gramineæ* or grasses, *Leguminosæ* or pulses, and *Cucurbitaceæ* or gourds. The two former afford life-supporting substances abounding in albuminous matters and those capable of repairing tissues accompanied with starch, gum, and sugar in such proportion as to support respiration and promote animal heat. They also provide the inorganic substances necessary to keep the circulation in a healthy state and to renew the solid frame-work of our bodies. Of these two orders the *Gramineæ* or grasses is the more important, containing as it does wheat, barley, rice, millets, maize, and sugarcane, which enter so largely into the food-resources not only of this country but of every country in the universe. To the *Leguminosæ* belong peas, beans, lentils, and gram. The gourds and cultivated vegetables are eaten more as a relish or to eke out a scanty supply of food-grain than as a sole food resource, and then only at certain seasons when their abundance and cheapness render them a favourite. The same may be said of fruits, cultivated and wild, and of the wild plants collected for food.

Analysis of the food-grains.

There are three forms of nitrogenous substances common to both animal and vegetable organizations distinguished by the names albumen, fibrine, and caseine; and it has been found that, when introduced into a living organism, each of these is capable of being converted into the other.[1] The principal ingredients of the blood of animals is found to be fibrine and albumen, and these substances contain, besides the carbon, hydrogen, and oxygen found in farinaceous products, such as the cereals, nitrogen, sulphur, and phosphorus, which abound in the pulses. These elements are also found in all parts of the animal organism except water and fat. It follows, therefore, that nutritious food must possess both albuminous and nitrogenous ingredients. The former are composed of carbon, hydrogen, and oxygen; the hydrogen and oxygen being in proportion to form water, thus leaving the carbon wholly unoxidised; or if we suppose the oxygen to be divided between the carbon and hydrogen, a surplus of carbon and hydrogen that is unoxidised remains. We are now speaking of what takes place after the food has been taken into the body and there submitted to assimilation. From the moment an animal is born until it dies oxygen is taken into its body through the skin and lungs, and given out again by the same channels in the form of compounds of carbon and hydrogen, or, in other words, as the vapour of water and carbonic acid. The latter is derived from the food eaten; for, when an animal is unable to take food, so long as it lives, it continues to inspire oxygen and give out compounds of carbon and hydrogen, which it obtains from the waste of the tissues of its own body. In fact death ensues from the action of the inspired oxygen, on account of its powerful affinity for carbon and hydrogen. When the animal has no longer superfluous carbon and hydrogen capable of combining with oxygen, it seizes on the carbon and hydrogen of the animal's own body; and, in the first instance, on the fat, which is almost all carbon and hydrogen, in order to satisfy the oxygen absorbed in the circulation, which afterwards goes off as carbonic acid in water. From the above it will be seen that food containing a surplus of carbon and hydrogen is necessary to an animal in order to support respiration without destroying its structure. But, besides defending the animal tissues and other parts from the action of oxygen, food maintains animal heat; for, whenever oxygen combines with a combustible, heat is developed; and that this does not depend on outward influences is shown by the fact that the heat of the body is the same in the tropics and in cold countries.

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[1] Based on the researches of Professor Mayer.

There are thus two great uses to which food is adapted by its composition—the nitrogenous to renew the blood and the non-nitrogenous to support respiration and maintain animal heat. But besides these there are other ingredients in food, the salts, such as iron, phosphate of lime, chloride of sodium with other salts of sodium, potash and magnesia, which occur also in the blood and bones, nails and hair. The following analyses of the principal cultivated food-grains are intended to show separately the quantity of these three principal ingredients present in each class of grain, and in doing so its comparative value as a food resource. A study of the *tables will corroborate in most cases the empirical verdict on the* value of each grain formed by the natives of these provinces, and give a scientific basis to their estimates, which would otherwise appear to be based on arbitrary data arising from their habits of life. The first series refer to the cereals, the second to the pulses, and the third to other vegetable products. We shall first, however, give Liebig's analysis of the three forms of nitrogenous substances found in animal and vegetable organisms for comparative purposes, and then Professor Mayer's ultimate analysis of the various food-grains.

Analysis of

	Albumen.	Caseine.	Fibrine.
Sulphur	1·30	0 9	1·0
Carbon	53·50	43 6	53 2
Nitrogen	15 50	15 8	17·2
Hydrogen	7·16	7·1	6 9
Oxygen	22 54	22·6	21·7
	100 00	100 00	100 00

Results of analysis A.

These are arranged in percentages so as to show the composition of the different substances existing in each vegetable product examined with their separate uses as life-sustaining compounds.

Names of products.	Nitrogenous ingredients.	Non-nitrogenous ingredients.	Inorganic ingredients.
CEREALS.			
Triticum vulgare, wheat, *gehún*, B.	11·45	83·15	2·40
Ditto, H.	10·15	79·77	0·70
Hordeum hexastichon, barley, *jao*, H.	11·72	84·80	2·84
Oryza sativa, rice, *dhán*, M.	0·08	89 08	0·47
Ditto, H.	7·10	91·60	0·36
Zea Mays, maize, *makai*, H.	14·66	84·52	1·92
Rye, B.	10·70	87 00	2·30
Do., H.	11 92	85 65	1·33
Penicillaria spicata, millet, *bájra*, M.	13·92	83 27	0·73
Eleusine Corocana, *mandua*, M.	18·12	80 25	1·03
Avena sativa, oats, *jai*, B.	13·93	82·07	1·00
Ditto, H.	15·24	80·05	3·26
Sorghum vulgare, *joár*, M.	15 53	83 67	1·26
PULSES.			
Ervum Lens, lentils, *masár*, H.	30·16	65·06	2·60
Pisum sativum, peas, *mattar*, B.	26·52	70·38	3·10
Ditto, H.	28·02	67·31	3·18
Phaseolus vulgaris, bean, *sem*, H.	28·64	66·70	4·38
OTHER VEGETABLE PRODUCTS.			
Solanum tuberosum, potato, *álu*, B.	9·50	86·50	4·00
Ditto, H.	9·96	86 36	3·01
Brassica Rapa, turnip, *shalgam*, B.	10 70	81·70	7 60
Ditto, H.	12 62	81·38	7 02
Beta vulgaris, beet, *chaukandar*, B.	10 70	83·00	5·30
Ditto, H, ...	15·50	73·18	6 48
Daucus Carota, carrot, *gájar*, H.	10·66	81·59	5·77
Brassica Napus, colza, H.	9 24	90·32	4·01

In the above table M. denotes an analysis by Professor Mayer; B. by M. Boussingault in his 'Économie Rurale;' and H. by Mr. Horsford in L. E. D., Phil. Mag., November, 1846, p. 365.

Results of analysis B.

Here the arrangement is in percentages so as to show the ultimate composition of each product examined, without reference to the different compounds existing in them or their uses as life-sustaining compounds:—

Names of products.	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ash.
CEREALS.					
Triticum vulgare, wheat, B.	46·10	5 10	13 50	2,30	2·10
Ditto, H.	45 69	6·76	43 23	3 00	0·70
Hordeum hexastichon, barley, H.	45 50	6 89	44.68	2 34	2·84
Oryza sativa, rice, M.	44·87	5 85	46·10	1 43	0·47
Ditto, H.	44 61	6 53	46·62	1·16	0·36
Zea Mays, maize, H.	45 01	6 60	44·62	2·11	0·86
Rye, B.	16·20	5 60	41·20	1,70	2·30
Do., H	44·37	6 65	41 55	1 87	1·33
Penicillaria spicata, bájra, M	44·18	6 13	41·09	2·19	0 73
Eleusine Corocana, *mandua*, M.	48·61	6 10	13·77	2·86	1·03
Avena sativa, oats, B.	50 70	6·40	36 70	2·20	4 00
Ditto, H.	46·50	6 64	45·59	2 39	3 26
Sorghum vulgare, *jodr*, M.	45 69	6·24	44·82	2·15	1·26
PULSES.					
Ervum Lens, lentils, H.	45 35	6 75	38·50	4 77	2·60
Pisum sativum, peas, B.	46·50	6 20	40 00	4·20	3·20
Ditto, H.	45·12	6·73	38.92	4·42	3·18
Phaseolus vulgaris, beans, H.	45·07	6·63	39 03	4 47	4·38
OTHER VEGETABLE PRODUCTS.					
Solanum tuberosum, potato, B.	44·00	5·80	44·70	1·50	4·00
Ditto, H.	43 86	6·00	44·79	1·56	3 61
Brassica Rapa, turnip, B.	42·90	5·50	42·30	1·70	7·60
Ditto, H.	43·19	5·68	42·96	1·98	7·02
Beta vulgaris, beet, B.	42·80	5·80	43·40	1·70	6·30
Ditto, H.	40·99	5·72	39 37	2 19	6·43
Daucus Carota, carrot, H.	43·34	6 22	43·90	1 67	5·77
Brassica Napus, colza, H.	45·32	6·01	16·68	1·15	4·01

The results of the preceding tables are supported by a further examination of the pulses grown in these provinces. The following table gives the average result of an analysis of several samples of each product taken from 'Panjab Products,' I., 243 :—

Names of products	Nitrogenous ingredients.		Carbonaceous or starchy ingredients		Fatty or oily matter.	
	In 100 parts . varies in specimens from different parts of India.					
Cicer arietinum, gram, *channa*	18·05	21·23	60·11	63·62	4·11	4·05
Ervum Lens, lentils, *masúr*	21·57	26·18	59·34	59·96	1·00	1·92
Lathyrus sativus, *kisári* (Calcutta specimen)	31·50	...	54·26	...	0·95	...
Pisum sativum, peas, *mattar*	21·80	25·20	58·38	62·19	1·10	1·12
Phaseolus aconitifolius, *moth* (Calcutta specimen).	23·80	...	60·78	...	0·64	...
Phaseolus Mungo, *múng*	23·54	24·70	59·38	60·36	1·11	1·48
P. var. *radiatus*, *urd* (Bombay specimen)	22·18	...	62·15	...	1·46	...
Vigna Catjang, *lobiya* (Bombay specimen)	24·00	...	59·02	...	1·41	...
Dolichos biflorus, *gahat*	23·03	23·47	61·02	61·85	0·76	0·87
,, *Lablab*, *shimi*	22·45	24·55	60·52	60·81	0·81	2·15
Cajanus indicus, *arhar*	19·83	20·38	61·90	61·32	1·32	1·86
Glycine Soja, *bhat*	37·74	41·54	29·54	31·08	12·31	18·90
Cyamopsis psoralioides, *gawár* (Púna specimen).	20·80	...	53·80	...	1·40	...

From an inspection of the preceding tables it will be seen that the pulses abound in nitrogenous elements so efficient in repairing the tissues, and next to them the cereals. A comparison with the analysis of the constituents of the blood will show that the composition of both is almost identical, and will also explain why experience has taught the natives of these provinces to mix together in their food, in certain proportions, cereals and pulses, the one supplying what the other is wanting in. Thus the flour of gram and peas is mixed with that of the cereals and especially with millet flour. Pulse bread is very seldom eaten alone, and then only locally and for some special reason.

The millets and the coarser pulses form the staple food of the hill population. Amongst the former the *mandua*, *janghora*, *koni*, *china*, and *mána*, and amongst the latter the *gahat*, *bhat*, and *rains*. The *mandwa* is either made into bread or into a porridge called *bári*, and the *china* and *koni* are also made into bread or boiled whole and eaten as rice. When travelling, the lower classes live chiefly on *satu*, the meal of parched barley, which only requires the addition of a little water to prepare it for eating. The following remarks of Traill still hold good :—

"Rice forms the favourite food of all those who can afford to purchase it. Wheat is only in partial consumption, chiefly on occasions of entertainments at marriages, &c., when the peculiar scruples of Hindus prevent the use of rice. Vegetables of all kinds, both cultured and wild, are objects of universal consumption ; among the latter description, not already noticed, may be mentioned the nettle, fern, *tulip*, *malú*, &c., of which the shoots, root, and bean, respectively, are eaten: the list of herbs, roots, and leaves, considered edble by the natives, is endless ; indeed, from their indiscrimination in this respect, fatal cases of poisoning sometimes occur. During the periodical residence of the agricultural classes in the Bhábar their principal food is the "*guiya*," or sweet potato, boiled and eaten with buttermilk. Animal food is in much request among all classes ; with the exception of those animals the use of which as food is prohibited by their religion, and excepting also reptiles of all descriptions and carrion birds or beasts, every sort of animal is converted to food in some part or other of the hills: by the southern Garhwális rats and mice are considered as dainties. The favourite flesh is that of the goat, or of the sheep, where bred: against the sheep of the plains an universal prejudice exists, its long tail rendering it, in the eye of the highlander, a species of dog. No scruple as to the mode of decease exists, and animals dying a natural death from disease, or other cause, are eaten by the Hindus as well as by the Doms."

Stewart also in his interesting report on the food of the people of the Bijnor district, which lies at the foot of the Garhwál hills, notices many points which have an interesting bearing on the lessons learned by experience as to the dietetical value and effect of each food-grain. He writes :—

"The prices of the various staple crops would appear to have a greater effect on the relative quantities of those consumed at different periods of the year than opinions connected with their wholesomeness, &c. Still, the latter consideration has its weight in determining the choice of certain kinds of food at certain seasons. Thus, in the cold weather, much more *bájra*, which is considered "heating," is consumed, with a large proportion of salt and spices, than at any other time; and in that season generally, one meal a day, at least, consists of pulse with rice in the form of *khíjri*. *Baghar*, or rice made into meal with its inner husk, is also a favourite kind of food in the cold weather. In the hot season, again, rice is the cereal most used, and this accords with the fact that its comparative consumption is found gradually to increase towards Calcutta, and to decrease towards Afghánistán, so that in the Upper Panjáb it constitutes a very small proportion of the food of the people, and wheat and maize are very much used. In the rainy season more wheat appears to be eaten than at any other time of the year, very often in the form of *gochni* bread, with about one part in four of pulse-meal. The labourer, if not in straits, always has two meals a day, the fullest being the morning one, at 6 to 8 A.M., before he begins, or during an interval of, his work; the evening one, after the day's labour is finished: but, of course, the change of the seasons, the weather, and the nature and place of his work, cause considerable variation in this respect.

"The staple of food of the labouring classes in this as in most other countries consists of one or other of the cereals, here generally combined with a considerable amount of pulse. From very many enquiries the average consumption of adult labourers, male and female, appears to be about ten or twelve *chhattáks* (20 to 24 oz.) a day of meal, or rice, with about two *chhattáks* (4 oz.) of pulse. The average weight of the adult males admitted into Bijnor jail in six months was—Hindus, one maund and ten seers (100lb.), and Musalmáns, one maund and eight seers (96lb.); and since this may be assumed as a tolerably close approximation to the average weight of the adult male inhabitants of the district, the above quantity of food seems liberal when compared with the amount which has been found to support healthy persons in Europe, where the average weight of individuals is probably considerably higher than here. Less invariable (than pulse) but still very frequent concomitants of the bread or rice consumed are greens and *tarkári* of gourds and other vegetables, and, in the season, one or two kinds of fruits, especially the mango. These not only have their uses in supplying fresh vegetable juices to the economy, but also add to and vary the sapid elements of the food, and thus, besides satisfying the natural craving for flavour, they also aid in stimulating the process of digestion, although, both theoretically and practically, an excessive amount of such food taken habitually is deleterious. A more constant error of the labourer is that of making his cakes too thick and under-cooking them. The reasons for this practice are, that it saves trouble, time, and fire, and produces the feeling of satiety with a smaller quantity. It is barely necessary to observe that the practice is calculated to injure digestion seriously (and in native regiments I have very often found that it materially interfered with convalescence from certain diseases of the alimentary canal). Hill men eat greedily all kinds of fruits, both cultivated and wild, and very rarely allow either to ripen thoroughly. The number of wild fruits and berries is very large, and the supply lasts from April to October, forming a welcome, though not perhaps always a healthy addition to their food.

"The average quantity of animal fibrine consumed by the labourer must be very small indeed, as meat is but rarely eaten by him, and then generally only in quantity sufficient to constitute a relish to his ordinary vegetable diet. The place of the oleaginous element which is, among meat-eating nations, mostly derived from flesh, is here filled by the very large amount of animal and vegetable oils consumed in various ways, especially as adjuncts in cooking vegetables, &c., and in the protei-form sweetmeats. The amount of spices taken is also large, and is probably, to some extent, necessitated by the rarity of the stimulus of meat, and by the considerable proportion generally borne by crude vegetables to the other articles of food. Sugar likewise is used in larger quantity than in temperate climates, but I should think not more than, if so much as, is used in other countries where the sugarcane is cultivated."

Watson's formula.

Dr. Forbes Watson has published a most useful table, showing the properties of nitrogenous substances which can be combined to the best advantage with carbonaceous ones; that is, of pulses to be combined with cereals arrowroot, sago, millets, and the like. By a simple formula we can find out the quantity of a pulse that should be added to a carbonaceous substance, provided only we know from previous analysis the amount of carbonaceous and nitrogenous matter in each, from which we can deduce the proportions of carbonaceous to nitrogenous in each, representing nitrogenous as unity.

Then, to find the quantity of one substance to be added to the other, we have this formula :—

Let the proportion of nitrogenous to carbonaceous in the given substance be $m : 1$. Let the proportion of nitrogenous to carbonaceous in the substance required to be added be $n : 1$.

Then the standard proportion or best possible combination (which is 6 carb.: 1 nit.:) $= p : 1$. Let the number of parts in the given substance be a, and the number required to be added be x, then—

$$x = \left\{ \frac{m\ (p+1)\ (n+1) - p(n+1)\ (m+1)}{(p-n)\ (m+1)} \right\} a.$$

Or simplified, $x = \left\{ \frac{(m-p)\ (n+1)}{(p-n)\ (m+1)} \right\} a.$ This will be clear from an example. Let it be required to know what proportion of a pulse, say gram, should be added to a hundred parts of arrowroot to give the best combination. By analysis we know that the proportion of carbonaceous to nitrogenous in arrowroot is 165·5 : 1, and in gram is 3·8 : 1 : then in the formula m will be represented by 165·5 ; n by 3·8 ; p by (the standard known) 6, and a by 100 : so

$$x = \left\{ \frac{(165{\cdot}5 - 6)\ (3{\cdot}8+1)}{(6-3{\cdot}8)\ (165{\cdot}5+1)} \right\} 100 = \left\{ \frac{765{\cdot}60}{366{\cdot}06} \right\} 100 = 2{\cdot}09 \times$$

$100 = 209{\cdot}0 =$ the number of parts required ; that is, that 209 parts of gram to 100 parts of arrowroot makes the best combination. This formula is of great value in settling jail and hospital dietaries.

A.—CULTIVATED FOOD-GRAINS.

Cultivated food-grains.[1]

The cultivated crops are divided into those of the *rabi* or sown in the autumn and reaped in the spring and those of the *kharíf* or *chaumás*, sown in the summer and reaped in autumn, exactly as in the plains, for the influence of the periodical rains is felt in all the hills on this side of the snowy range. In the hills, the staple crops are the same as they were sixty years ago, wheat and barley in the spring, and rice and *mandua* in the autumn; in the tract along the foot of the hills rice and arum are the principal rain-crops, and wheat, barley, and mustard the chief spring crops. Dividing the cultivated food-grains amongst the great natural orders, we have as follows :—

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[1] A botanical description of each of these plants will be found in my 'Notes on the Economic Products of the North-Western Provinces,' Part IV., Allahabad, 1881.

GRAMINEÆ OR GRASSES.

Triticum vulgare, Linn., wheat—*gehún, náphal.*
Hordeum hexastichon, Linn., barley—*jau*
„ *himalayense*, Linn., celestial barley—*ua-jau.*
Oryza sativa, Linn., rice—*dhán*
Zea Mays, Linn., maize—*bhútta, júnala, mungari.*
Paspalum scrobiculatum, Linn.—*kodo, kodra.*
Panicum miliaceum, Linn.—*china, gandra.*
Oplismenus frumentaceus, Link.—*mandira, jhangora.*
Setaria italica, Kth—*kauni, koni, kákni.*
Penicillaria spicata, Lam.—*bájra.*
Eleusine Coracana, Gœrtn.—*mandua.*
Avena sativa, Linn., oats—*jai.*
Sorghum vulgare, Pers.—*joár, júnali.*
Saccharum officinarum, Linn., sugarcane—*ikh, rikhu, ganna.*

LEGUMINOSÆ OR PULSES.

Cicer arietinum, Linn., gram—*chana, chola.*
Ervum Lens, Linn., lentils—*masúr.*
Vicia Faba, Linn., bean—*bákla.*
Lathyrus sativus, Linn., *kisari, chapta.*
Pisum sativum, Linn., pea—*kalon, kulai.*
Phaseolus aconitifolius, Jacq—*moth.*
„ *Mungo*, Linn.—*mung, chhimi*
P. Mungo var. *radiatus*, Linn.—*urd, mash, chhimi, rutndar.*
„ *torosus*, Roxb.—*guransh.*
Phaseolus vulgaris, Linn., bean—*shimi, sem*
„ *multiflorus*, Willd., scarlet runner.
„ *coccineus*, Lam., ditto variety.
Vigna Catiang, Endl—*lobiya, riansh.*
Dolichos biflorus, Linn.—*gahat.*
„ *Lablab*, Linn.—*shimi.*
Cajanus indicus, Spreng.—*arhar, rahar, túr.*
Glycine Soja, Sieb.—*bhat.*
Cyamopsis psoralioides, D. C.—*gawár.*

CHENOPODIACEÆ.

Chenopodium album, Linn.—*bethua.*

AMARANTACEÆ OR AMARANTHS.

Amaranthus frumentaceous, Buch.—*chua*.
" *caudatus*, Moq.—*kedári chua*.
" *Blitum*, Linn.—*chamli*.

POLYGONACEÆ.

Fagopyrum esculentum, Mœnch., buckwheat—*ogal, pálti*.
" *tataricum*, Gœrtn., buckwheat—*phápar*.

CEREALS.[1]

Triticum vulgare, Linn.—Wheat, and **Hordeum hexastichon**, Linn.—Barley. There are four recognized varieties of wheat :—(1) *gehún sufed* or white wheat ; (2), *dáúd-khání* or *dára*, a white awnless variety grown in large quantities in the Kosi valley near Somesar ; (3), *daulat-khání* and (4) *lál-gehún*, *tánga* or *jusher*, the bearded varieties. Wheat is called generically *kanak* or *gehún*, and by the Bhotiyas *náphal*. The flour is known as *áta* or *kunnik*.

There are also several varieties of barley known generically as *jau ;* a short-awned variety is called *rena*. When barley is sown and reaped together with wheat, the mixed grain is called *gojai ;* and with gram or peas or lentils, it is known as *bijra*. In both these cases the grains are grown together and cooked and eaten as one. Mixed wheat and gram is called *gochni* below the hills.

Wheat and barley usually follow rice in the same fields. These are prepared in Asauj (September-October) by ploughing and cleaning, and, when practicable, they are irrigated by turning into them a stream from some river. The irrigated fields are sown in October-November and the uplands in November-December. The seed is sown in furrows (*siya*), which are again covered in by the plough, whilst the clods are broken by the *dalaya* and again smoothed by a heavy flat wooden log (*maya*) drawn by oxen and kept steady by a man standing on it. Barley ripens in March-April and wheat a month later, and yield about tenfold the seed sown. Both are cut in the middle of the stalk with a sickle and tied in sheaves (*ántha*) and stacked near the homestead to dry. When dry, the sheaves are unbound and threshed out by a flat wooden board with a short handle known as *mungra*. In some of the north-eastern

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[1] A botanical description of each species and full notes on localities, uses, &c., will be found in my 'Notes on the Economic Products of the North-Western Provinces,' Part IV.

Pattis of Kumaun a primitive form of *flail* is used in the shape of a long pliant stick. The chaff is used as fodder; cow-dung ashes (*khariya*) are mixed with the grain when stored, to prevent the attacks of insects. The variety *H. Ægiceras*, mentioned by Thomson (p. 102) as that 'curious, awnless, monstrous barley,' is peculiar to the highlands of Tibet, where it is extensively cultivated. It ripens in August in the Pruang valley. At the same time that wheat is sown, and often on the borders of the same fields, *masúr* (*Ervum Lens*) and gram (*Cicer arietinum*) are cultivated in quantities.

Hordeum himalayense (*cœleste*)—*Ua-jau*, the *cháma* of the Bhotiyas of Dárma.

This species is only grown in villages bordering on the snowy range and at high elevations, 7-12,000 feet. The seed is sown in first-class unirrigated land in October and ripens in May. The average yield per acre is about fifteen loads, worth one rupee a load, and raised at a cost of about eight rupees an acre. The produce is consumed locally by the Bhotiyas, being esteemed much too poor a food for the lowland folk.

Rice.

Oryza sativa, Linn.—Rice. This widely-distributed grain is, as may be supposed, the principal rain-crop in the lowlands, and is also largely cultivated in the hills up to 6,500 feet, where some of the most valuable varieties are raised in the deep, hot valleys. It is an annual, belonging to the natural order *Gramineæ*, having numerous culms, erect, jointed, round and smooth, the leaves sheathing and long, scabrous outside and the panicles terminal. The local names of the varieties are almost endless; the principal recognized in the Kumaon Division are the following:—

Dhán.
Bánsmáti.
Hansráj
Gajlo.
Uya.
Jamol.
Bakuwa.
Timtliya.
dhesuwa.
dúda.
sishali.
anjan.
amdrasi.
sál.
katyúri.
gajaliya.
sathiya.
dhaniya.
banpása.
rauliya.
kirmuli.
nauliya.
rakasuwa.
muthamuth.
dháni.
badatiya.
haltuniya.
motiya.
adarat.
maisuwa.
andi.
geruwa.
makani.
jogyána.
ratuwa.
akari.
rasiya.
parayal.
chúnkuli.
chinabhuri.
batasuwa.
makurat.
rájbhati.
rupasuwa.
halduwa.
mandhuri.
sálam.
páliya.

In the hills, the agricultural year commences about the middle of February, when the land has to be prepared for the rice-crop, which is usually sown where *mandua* has been raised in the previous season. The manure from the cattle-sheds is spread over the ground which is then ploughed and freed from stones. The terrace walls are repaired and the roots of the *mandua* from the last crop are collected and burned. In Baisákh (March-April) or Jeth, (April-May), the land is ploughed again and the seed is sown in the furrows, which are closed by a flat log of wood drawn along them. When the young plants have risen to some three or four inches in height, a large rake or harrow is drawn over the ground to remove the weeds and thin the plants. Where water is abundant, the better sorts of rice are sown in a highly-manured and irrigated nursery (*bihnora*) or seed bed. This is first flooded with water and then ploughed until the soil becomes a semi-liquid mass. Manure is then added and the seed is sown on the top and covered over with leaves, especially those of the *chír*, which are said to decompose easily in water and form an excellent top-dressing manure. The young plants are transferred (*ropa*) from the nurseries by the women and children in June-July to the open field. The manure used is commonly the sweepings of the cattle-pens, which are collected in regular heaps on a place set apart for it in the field, usually that in which the cattle have been regularly penned (*khatta*), to economise the collection of their droppings. Leaves also are collected and allowed to rot in heaps on the field, and twigs and branches of trees are burned and the ashes made use of. The latter are usually taken from the village forests and cost nothing but the labour in gathering and stacking them. When the field is a small one, the earth is loosened and the weeds removed by a small iron sickle (*kutala*). In July-August the weeds are again removed, whilst the land is kept inundated with water, and by the end of August the poorer highland varieties are ready, and by the end of September or beginning of October the finer sorts grown on the lowlands. Rice is cut from the root and stored on the field in stacks (*kanyúra*) with the ears inwards. There it is left for four or five days to dry, and after that the grain is trodden out by cattle on a threshing-floor paved with slates (*khala*) or simply by men on mats (*moshta*). The stalks (*puwál*) are made up in bundles (*púla*) and stored round a pole or in the fork of a tree and afford food for cattle and bedding for the poor. The grain is taken home, and, after being dried on the roof of the house, is stored for use in boxes (*bhakár*) or in baskets plastered with mud or cow-dung, called *korangas* or *dálas*. Unhusked rice is known as *dhán* in Kumaun; and before husking it is again dried in the sun and then pounded in a wooden or stone mortar called an *ukhal*. The pestle (*musal*) in use is tipped with iron, and the grain is pounded three different times before the clean rice or *chánwal* is produced. The chaff (*chila*) is used as fodder for cattle, and the husk (*pithi*) of the third pounding, by the poor. Winnowing is performed by a shovel-shaped basket (*supa*) which is held at such an angle to the wind as allows the chaff to fly off, or the grain is placed on the ground and the basket is used as a fan. One *náli* or about four pounds of rice-seed produces in irrigated land 35 *nális* of unhusked or one-half that amount of husked rice, and rice-seed in upland unirrigated land about half as much. Dry upland rice ripens from early September; common irrigated rice from early October *and the better irrigated sorts from the middle of* October. In Dehra Dún there are three principal varieties,[1] the *chaitru*, *haltyu*, and *kyári* or transplanted. The first, which is also known as *chambu* or *anjana*, is sown in unirrigated land in March-April (*Chait*) and is cut in August-September. *Haltyu* is sown a month later in similar land and is cut in September; it is also known as *anjani* and *naka*. The *kyári* furnishes rice of the best quality; the seeds are sown in nurseries in April-May, and the young plants are transferred in the following two months to wellirrigated fields, where they are carefully weeded. The principal varieties are the *ramjawáin* and *básmati*, and these grow best in warm valleys and along the great rivers where there is much moisture. *Chánwal* cooked in water is called *bhát*, but the broken grains (*kanika*) when cooked are called *jaula*. *Khijri* is a mixture of rice with *urd* or *bájra* boiled together in water; and *khír* is rice boiled in milk. The commoner varieties are often made into bread, and in that case the grain is only husked once and the inner husk is left on to be ground into flour, called *baghar* in Garhwál.

Zea Mays, Linn.—Indian-corn, maize;—*Bhútta*, *mukui* (Kumaun); *mungari*, *júnala* (Garhwál). The maize plant is grown in small quantities in the hills for the heads which are usually roasted whole, and the seed is then eaten from the cob (*chúchi*). The seed is sometimes ground into flour and made into bread either alone or with the flour of *moth.*

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[1] Memoir, 22.

Paspalum scrobiculatum, Linn.; *P. kora,* Willd.—*Kodo, kodra, kodram.*

An annual belonging to the natural order *Gramineæ* and sub-order *Paniceæ*, cultivated in the sub-Himálayan districts. Dr. J. L. Stewart writes[1] of the Bijnor district: "*Kodra* is said to produce cholera and vomiting, and I find that some authors mention a similar phenomenon as occasionally occurring in all three presidencies. The natives generally hold that with the ordinary *kodra*, and undistinguishable from it, grows a kind that they call *majna* or *majni* which produces the above effects, but it has been suggested with greater probability that these depend on the use of the new grain under certain conditions." These results are, however, uncommon, as they are seldom met with, and the grain is a favourite one for home consumption amongst the poorer classes. It is husked with the pestle (*músal*) and frequently eaten unground called *chánwal* in the Bijnor district, a term usually applied to husked rice. *P. longiflorum,* the *kána* of Kumaon, grows wild and its seeds are also used as food. Roxburgh, 93; Drury (F. P.), III., 565.

Panicum miliaceum, Linn.—The *chína* of the hills and *chínia sáwán* of some places, of which the *gandra* or *gandri* variety (*P. uliginosum*?) is grown extensively in the Bhábar. It is an annual with erect, round culms, belonging to the natural order *Gramineæ* and the sub-order *Paniceæ.* It is cultivated in the hills up to 6,000 feet and the sub-Himálayan tract, and is noted by Madden as apparently wild at Háwalbágh. It is a very delicate plant, sown in March; it ripens in May in the Bhábar, and is grown chiefly for immediate consumption. In the hills it is occasionally sown in May-June up to 6,000 feet in a few villages and ripens in August. The average outturn per acre in the hills is about 25 loads of unthreshed grain, worth about Rs. 20, and raised at half that cost. The seeds are white and smooth like sago, and are considered a fit food for invalids. They are husked by the pestle and mortar, and, like *kodra*, are often eaten unground under the name *chánwal* in the Bijnor district. It is known as a *tínpákh* or "three-fortnight" grain, that being the time required for its production from sowing to cutting, and is therefore one of those allowed as food to devout Hindus during fasts. *P. brizoides*, Jacq., is occasionally cultivated under the name *bárti* for the same purpose. Roxburgh, 104.

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[1] J. Agri.-Hort., XIII., sec. 50.

Oplismenus frumentaceus, Link.—the *mandira* and *jhangora* of Kumaun, *jhíngara* of Garhwál, the *sáman* of the Bhábar, and *sáwan* of the plains; *syámák*, Sanskrit.

This is a small hardy annual belonging to the natural order *Gramineæ* and sub-order *Paniceæ*, cultivated throughout the hills up to 6,500 feet and in the submontane tracts. It thrives best in soils tenacious of moisture or which receive plenty of rain, and is sown in July and gathered in September. The ears are cut first, and the stalks afterwards as fodder for cattle. It is also one of the "*tínpákha*" or "three-fortnight" grains, coming to perfection in about six weeks. It has culms erect, 2-4 feet high, panicle erect; spikes secured, incurved; flowers three-fold unequally pedicelled; leaves large, margin hispid. The grain is considered heating, but when kept for four or five years loses that quality. It is chiefly consumed by the poorer classes made into *khír* (boiled with milk), *khuskhál*, *khijri*, &c. It is the *Panicum frumentaceum* of Roxburgh, 102. *O. colonus*, Kth., occurs wild and occasionally cultivated or rather allowed to grow under the name *jangli-mandira*.

Setaria italica, Kth.; *Panicum italicum*, Linn.; *Pennisetum italicum*, R. Brown.—Italian millet. The *kauni*, *koni* of the hills, *kákni* of Bijnor, and *kangni* of the plains.

This is an annual with culms erect, 3-7 feet high, round, smooth; roots issuing from the lower joints; margins of leaf hispid; mouths of the sheaths bearded; spikes nodding; spikelets scattered; seeds ovate; cultivated in the hills up to 6,500 feet and in the submontane tracts. In the hills it is sown with *mandira* or along the edges of rice-fields for home consumption in April and gathered in September. An unmixed field of *kauni* is very uncommon. The ears are cut off while the crop is standing and the stalks are only used as bedding for cattle. As a food, natives consider it to be cool and dry, astringent and diuretic, and to be of use externally in rheumatism. When taken as the sole food it is said to be apt to produce diarrhœa. It renders beer more intoxicating. In Madras its flour is highly esteemed for pastry. Roxburgh, 102; Drury (U. P.), 338.

Penicillaria spicata, Willd.—Spiked millet—*Bájra.*

This millet is also occasionally grown along the foot of the hills and in the lower valleys within the hills, but *bájra, jodr*, and maize are essentially plants of the plains proper. Roxburgh, 95.

Eleusine Coracana, Gœrtn.; the *mandua* or *maruwa* of the hills, *kodo* of parts of the western hills and *raghi* of the south of India. *Mandua* belongs to the natural order *Gramineæ* and sub-order *Chlorideæ*, and has an erect culm supporting from four to six spikes, digitate, incurvate, from one to three inches long, composed of two rows of sessile spikelets, each consisting of from three to six flowers. Calyx formed of two glumes: seed covered with a thin, pellucid, membraneous aril. It is the staple autumn or *chaumás* (*saoni* in Dehra Dún) crop of the highlands (up to 8,000 feet) between the Tons and the Sárda, and forms the main food-resource of the agricultural classes. It gives a larger yield than other crops, and is said to increase in bulk when ground, qualities that have probably led to its more general cultivation, as it is a poor and very coarse grain. Indeed, Madden terms it "a bitter and indigestible food." *Mandua* is cultivated both in ordinary agricultural land and in freshly cleared jungle. In ordinary land, it usually follows a wheat crop which is gathered in April-May, and the land is at once prepared for the *mandua* in the same manner as for rice. The seed is sown broadcast, and, instead of a harrow, the bough of a tree is drawn over the newly-sown land to cover the grain. When the young plants have risen two or three inches, the whole field is harrowed two or three times and the vacant spaces are filled up from those where the plants are in excess. Seeds of the *gahat, urd, bhat*, and other similar grains are then sown in the midst of the *mandua*, and their produce is collectively called *kán* in Kumaun. Later on the crop is well weeded with the *kútala*, and in October-November the ears of the *mandua* are cut off and the *kán* are rooted up. Afterwards the stalks (*naluwa*) of the *mandua* are cut and tied in bundles and stacked like those of rice to serve as fodder, or cattle are driven into the field and allowed to consume them. The ears of the *mandua* are stacked (*thupara*) for some twenty to twenty-five days, when they begin to ferment, and, when warm, they are spread out and dried and are then threshed out by a flail (*saila*), or are trodden out by cattle. Winnowing is performed by the *súpa* as in the case of rice, and the heap formed is then passed through a sieve (*rangra*) before being stored. The chaff (*dhúsi*) is used as fuel for cooking and its ashes as a dye and for washing clothes. The chaff (*nat*) of the *kán* is useful for fodder. *Mandua* is ground into flour of a somewhat rough and astringent taste, and made into unleavened cakes or a kind of porridge called *bári*. A spirit called *dáru* is also made from it and sells at from three to six annas per bottle. A variety called *mandín* has usually 3-4 spikelets which are not incurvate and ripen in September. *E. indica*, the *mandavi* of the tract along the base of the hills, is common in the hills and Bhábar.

The rent per *bisi*, which is only forty square yards less than an acre, varies from one-fourth to one-half the crop, and may be set down as about two rupees. The cost of ploughing and harrowing where cattle are hired would be about two to two and-a-half rupees per *bisi*, and for labour whilst the crop is on the ground about the same amount. Seed, sowing, cutting and cleaning the grain about three rupees,[1] giving a total expenditure of ten rupees per *bisi*. The average outturn is between fifteen and twenty maunds of forty seers each, worth about one rupee a maund. *Mandua* is one of the favourite crops with squatters in the forests. Their mode of operation consists in felling the timber and clearing patches along the ridges in autumn, and when the timber is dry it is burned in spring, and *mandua* is then sown in the ashes and lightly ploughed in or hoed in by hand. No other labour is required beyond roughly fencing in the patches with the half-burned logs and watching them at night to prevent the incursions of wild animals. The cost of production is much less than in ordinary land, and no rent is paid, as but one crop is taken, after which the patch lies fallow for from six to twelve years. This mode of cultivation is, according to the nature of the soil, known as *katil, kála banjar* or *ijrán* in Kumaun and as *khil* or *kándala* in Garhwál. In ordinary land there is a formal rotation of crops. Thus, rice is sown in April and gathered in September, after which the land is prepared and yields a crop of wheat or barley, which is cut in April, and is succeeded by *mandua,* and as the last is not ready for the sickle until November, the land is allowed to remain fallow until the following spring, when rice is again sown. Where land has been long allowed to lie fallow, a crop of *mandua* or *chúa* or buckwheat is usually taken first, and, as a rule, a field is allowed to lie fallow after every third crop, except in a bad year. In the Bhábar, mustard is sown in August and gathered in February, when it is followed by the *ganára* variety of millet which is ripe in May. Then wheat is sown, which is followed by rice in the next spring. In the older villages nearly half the land, especially that on which rice has been sown, is allowed to lie fallow one season. In new villages land is cropped without intermission for several years. Roxburgh, 115; Drury (U.P.), 206.

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[1] Sowing four annas; seed at twelve seers per *bisi*, eight to ten annas; cutting and winnowing, for the former eight and the latter four men, would cost from 24 to 30 annas

Avena sativa, Linn.—Oats—*Jai, wiláyati-jau. Jai* is grown in small quantities in the hills (6-10,000 feet) and in the Dún for local consumption. In the hills it is usually sown mixed with barley and the two are eaten ground up together. *A. fatua* seems to occur wild.

Sorghum vulgare, Pers.; *Holcus Sorghum,* Linn.—Great millet—The *júnali* of the Bhábar and *joár* of the plains.

This millet is grown in very small quantities near houses here and there in the Bhábar and in parts of the hills up to 5,000 feet. *S. Halepense,* Linn., occurs wild in the Bhábar, under the names *baru* and *rikhonda. Júnali* is grown in the plains for its seed and sown closely as a fodder, which is acceptable to, and greedily eaten by, cattle of all sorts, notwithstanding the size of the stalks. Roxburgh, 90; Drury (U.P.), 413 ; Steudel, 384.

Saccharum officinarum, Linn.—Sugarcane—*Ikh, rikhu, ganna, puna-rikhu* (large variety), *kanthi-rikhu* (small variety). Though the sugarcane is not a food-grain, it may be noticed here as belonging to the *Gramineæ.* It is only occasionally cultivated in the hills, notably near Dwára Hát and Gangoli Hát, but is largely grown in the submontane tract and the Tarái. The details of manufacture for export do not differ from the system generally observed elsewhere.

PULSES.

The pulses belong to the natural order *Leguminosæ* or pea-tribe, and afford a large quantity of the food-resources from the vegetable kingdom in these provinces. Of those raised by field cultivation, *múng*, *másh*, and *masúr* are often eaten unhusked by the poor. The two first and gram or *chana* are held in high repute, though all are considered, when eaten alone, to be apt to produce colic and flatulency. Gram, peas, and a few others are occasionally ground into a flour called *besan* and made into bread either alone or in the proportion of one-fourth with cereals. Thus, wheat is ground with gram, maize with *urd*, and the millets with *moth*. Pulse bread alone is only resorted to when nothing better can be obtained. *Másh* and *múng* split in two and then known as *dál* are usually eaten separately or with rice, when the mixture is called *khijri*. *Múng* and *arhar* are reckoned as good nutritious food for invalids, but *moth* and *masúr* are considered less valuable as causing heat and thirst. *Masúr* is said to be the source of the well-known Du Barry's *Revalenta Arabica* Gram, peas, *múng*, *moth*, and *lobiya* are frequently parched by tradesmen known as *bhúnjas*, and, under the name *chabena*, form the usual food for persons going on a journey or employed so as to prevent their being able to cook their regular meals. The usual mode of preparation, however, is to boil the pulse, after removing the pod, and serve with condiments of various kinds as shred onions, turmeric, spices, &c. Eaten with boiled rice, they form one of the staple dishes of the country (*dál-bhát*), and in this form are said to be most wholesome, the cereal correcting, to a certain degree, the heating properties of the pulse.

Cicer arietinum, Linn.—Gram—*Chana*. The gram plant is sparsely cultivated in the hills. It is a naturalised plant, a native of Europe, deriving its name from the pea having a supposed resemblance to a ram's head (*aries*). It belongs to the natural order *Leguminosæ* and sub-order *Vicieæ*. There are four varieties, black, white, red, and yellow, the last of which is that usually found here. It is cultivated in the warmer localities, usually as a border to wheat, and ripens in February. The *bhúsa* of the stalks and leaves forms a valuable fodder for cattle and horses, and the green leaves are eaten as a pot-herb. Hook. Fl. Ind., II., 176: Roxburgh, 567. *C. microphyllum*, Benth., a wild species growing in Tibet, is remarkable for *a very viscid exudation* and *its strong odour* (Thomson's Travels, 371): Drury (U.P.), 134.

Ervum Lens, Linn.; *Cicer Lens*, Willd.—Lentils.—*Masúr*, an annual belonging to the natural order *Leguminosæ* and sub-order *Vicieæ*, is sparsely cultivated in the hills, but is increasing in favour in the Bhábar. The seeds split in two are used as a *dál*, but they are commonly regarded as heating. It also is sown at the border of fields and ripens in February. Roxburgh, 567.

Vicia hirsuta, Koch. This plant is found wild near Almora, and is occasionally cultivated as a fodder under the names *masúri*, *masúr-chana*, and *jhanjhaniya-kúri* up to 5,000 feet in Kumaun and also in the Tarái. Hook. Fl. Ind., II., 177.

Vicia Faba, Linn.—The garden bean—*Bákla*. This bean is cultivated occasionally for its seed and straw up to 8,000 feet. There are several varieties sown from introduced seed or native seed either in fields or gardens. *V. sativa*, Linn., var. *angustifolia* (Hook Fl. Ind., II., 178) and *V. tenera* occur wild.

Lathyrus sativus, Linn.—The chickling vetch—*Kisára*, *churál*, *chapa*, *mattar*, *kása*. This species is occasionally cultivated below the hills and in the hills up to 8,000 feet. The evil effects of this pulse is unknown in Bijnor and the Bhábar, though it is said to produce paralysis in Allahabad. *L. sphæricus*, Retz., and *L. Aphaca*, Linn., are found wild.

Pisum sativum. Linn.—The field-pea—*Kalon*, *kulai*, *batana* (Jaunsár). This well-known annual has been introduced from Europe. The seeds are round, of uniform colour, and there are 5-6 leaflets. Another species, *P. arvense*, Linn., having 2-4 leaflets and compressed marbled seeds, is said by Royle to be a native of India. It is cultivated in small quantities up to 8,000 feet in the hills. Hooker, Fl. Ind., II., 181.

Phaseolus aconitifolius. Jacq.—The aconite-leaved kidney bean—*Moth*. This species is chiefly grown in the submontane tract in the poorest soils and is of little account amongst food-resources here except in dry seasons. Hooker, *ibid.*, 202 : Roxburgh, 558.

Phaseolus Mungo, Linn.—The small-fruited kidney bean.—*Múng, chhími, chikan,* and var. *radiatus,* Linn.—rayed kidney bean; *urd, másh, chhími ruindár.*

Both these varieties are cultivated in Kumaun up to 4,500 feet. The former is rare and has greenish yellow flowers, pods 10-15 seeded, and seeds with numerous longitudinal close streaks. There are four varieties, green, black, yellow, and white, of which the first is most common : ripens in October. The second has yellow flowers, pods very hairy, 4-6 seeded ; two varieties, black and green, and a third smaller plant occurs called *urdi.* It is a rain crop and is more commonly cultivated in the hills up to 6,000 feet. It is considered the most heating of all the pulses and is seldom eaten alone. Hooker, *l. c.*, 203 ; Roxburgh, 556. *P. Mungo* of Roxburgh is the common green *múng* ; the black variety is his *P. Max* and the yellow variety is his *P. aureus,* whilst *P. Roxburghii,* W. *et* A., is the same as *P. radiatus,* Linn., *urd* or *másh,* now reduced by Aitchison (p. 389) to a variety of *P. Mungo,* Linn.

Phaseolus torosus, Roxb.—*Guraush, gúránsh.* This species is grown at a higher elevation than any other pulse (6,500 feet), chiefly in Káli Kumaun, but also in Almora and the Bhágirathi valley up to 4,500 feet. It is apparently a cultivated form of *P. calcaratus,* Roxb. (Hooker, II., 204). There are two varieties, one of which has a red and the other a cream-coloured seed : ripens in October. Roxburgh, 558.

Phaseolus vulgaris, Linn.—French bean—*Shiuchana, bákula.* This and *P. multiflorus,* Willd. (scarlet-runner) are chiefly grown in gardens as pot-herbs. *P. coccineus,* Lam., differs by its bright scarlet, casually white, flowers arranged in long racemes which often overtop the leaves. Hooker, *ibid.*, 200.

Vigna Catiang, Endl. ; *Dolichos sinensis,* Linn. : both are now united—*Lobiya ridnsh, ráish, riensh.*

The first is low and sub-erect with pale purplish flowers ; the latter is tall and voluble. There are several varieties differing in the colour of the flowers and seeds (white, brown, yellow, black). Three or four are cultivated in Kumaun (up to 4,000 feet), of which one is known as *sonta*. All the varieties are usually sown with other crops. The young legumes are eaten as a vegetable and the ripe seeds in curries. Hooker Fl. Ind., II,, 205 ; Roxburgh, 559, 560.

Dolichos biflorus. Linn.—Horse-gram— *Gahat, kalath,* the *kulthi* of the plains. The horse-gram is occasionally grown in the hills up to 6,000 feet and in the submontane tract. In the Bhábar it ripens in October. Hooker, *l. c.,* 210 ; Roxburgh, 563.

Dolichos Lablab, Linn.—Black seeded kidney-bean—*Shími, chími.* Six varieties of this species are commonly cultivated in gardens and very occasionally as a field-crop. Hooker, *l. c.,* 209 : Roxburgh, 560 : Drury (U. P.), 282.

Cajanus indicus, Spreng. ; *C. flavus* and *bicolor,* D. C. ; *Cytisus Cajan,* Linn.—Pigeon-pea.—*Arhar, rahar, tor, thohar.*

The pigeon-pea is occasionally cultivated in the hills up to 4,000 feet and in the submontane tract as a border to other crops and has a reputation for being easily digested and nutritious. *C. flavus* has the vexillum yellow, whilst *C. bicolor* has it beautifully veined with purplish red ; the latter is more commonly cultivated in Kumaun.

Glycine Soja, Sieb. ; *Soja hispida,* Mœnch.—Soy bean—the *bhat* of Kumaun, *bhatnas* and *bhatwas* of Nepál and northern Tirhút, and *Khajuwa* of the Tarái. This bean, though a poor food resource, is extensively grown in the hills 4-6,000 feet, as food for men and cattle. It ripens in October. Hooker, *l. c.,* 184 ; Roxburgh, 563.

Cyamopsis psoralioides, D. C.—the *gawár* of Meerut and *kauri, syámsundari, phali-gawár, kawára* and *kachhár* of the submontane tract. It is sown with other rain crops or along the borders of the fields in the rains in favourable places, but will not stand either excess of moisture or high winds. The legumes are delicate and are used in vegetable curries when young, and when mature they are boiled and with a little mustard-oil given to cattle as a condition fodder. Drury (U.P.), 179.

CHENOPODIACEÆ.

Chenopodium album, Linn.—Goosefoot—*Bethuwa, chardi, jau-ság.* An annual which occurs (cultivated occasionally) in the hills up to 4,000 feet. It is gathered for its seed, whilst the young leaves are used as a vegetable. It is entirely a rain crop and attains a height of six feet. The seeds ripen in October and are considered nutritious. Roxburgh, 260.

AMARANTHS.

Amaranthus frumentaceus, Buch.—Prince's feather—*Chúa, chúa-mársa, rámdána, anárdána* of these hills and *batu, báthu, bathua* of Bisahr. There are two varieties, the red and yellow, both of which belong to the natural order *Amarantaceæ* and sub-order *Achyrantheæ*, pentandrous; stems and branches erect; leaves broad-lanceolar; panicles erect; leaves of the calyx daggered; capsules wrinkled, seed, solitary, round, pellucid with callous white margins. Calyx longer than the stamens; leaflets in both male and female with subulate points. Male flowers with five stamina: female flowers with 2-3 styles. *Chúa* is largely grown in the northern parganahs up to 9,500 feet, where it forms the staple food of the poorer classes and is a favourite crop in newly-cleared jungle, as it is not easily injured by bears and deer. It is sown in May and June in first and second class unirrigated land and yields about twenty loads to the acre. The produce of an acre is worth about sixteen rupees, and the estimated outlay is about half that sum. From an experiment conducted in the Botanical Gardens in Calcutta it was found that forty square yards of ground sown with this plant in June yielded twenty-one pounds weight of clear ripe seed in September, or thirty-one maunds to the acre. It also grows well from October to February in the plains. Some identify *chúa* with *A. Anardana* (*farinaceus*), and much remains to be done to clear up the synonymy of the amaranths. Roxburgh, 663.

Amaranthus caudatus, Linn.—Love lies bleeding—the *kedári chúa* of the hills. This species has an erect stem angularly-striated, glabrous, green; leaves long, petioled, ovate or rhombovate, narrowing at both ends, bluntish, emarginate, glabrous, green; spikes ascending: flowers sessile, green: bracts longer than the sepals, which are three in number. Cultivated in gardens or near the homestead in the hills for local consumption. The seed is sown in May-June and the crop is ripe in October. Drury (F. P.), III., 21.

Amaranthus Blitum, Linn.; Var. *polygonoides*, *A. polygamus*, Linn. Hermaphrodite amaranth.—*Chamli ság, chauldái*. This common species is sometimes grown along the edges of fields in the submontane tract as a pot-herb. Like all the amaranths, it is one of the *phaláhas* or food-grains which Hindus may eat during fasts.

POLYGONACEÆ.

Fagopyrum esculentum, Mœnch.—Buckwheat—The *ogal* of Kumaun, *kotu* of Garhwál, and *pálti* of the Bhotiyas. The Himálayan buckwheat belongs to the natural order *Polygonaceæ* and sub-order *Apterocarpeæ.* It is grown chiefly as a vegetable in the hills and is recognisable by its red flowers. It is frequently sown in newly-cleared forest land and ripens in September. The grain is exported to the plains under the name *kotu* and is eaten by Hindus during their fasts (*bart*), being one of the *phaláhas* or food-grains lawful for fast-days. It is said to be heating, but palatable, and is sold by the *pansári* or druggist, and not by the general grain-dealer. *F. cymosum,* Meissn., the *ban-ogal* of Kumaun, occurs wild in the lower hills.

Fagopyrum tataricum, Gœrtn. ; *F. emarginatum.*—Buckwheat,—called *phápar* or *páphar* by the Kumaunis and *bhe* by the Bhotiyas. It has a white or yellow flower and only grows at high elevations, 7-12,000 feet. It ripens towards the end of September or beginning of October. The seeds are oval, acute, nearly triangular with acute, smooth, brilliant angles, the size of a hemp seed, of ash-brown colour, whilst the seeds of the *ogal* are rounded.

B.—CULTIVATED VEGETABLES.

The vegetables grown in the Kumaun division are those noted below, which may be divided into three classes : (1) those like the gourds and melons that are eaten raw or cooked ; (2) those generally boiled in water with salt and spices or cooked with *ghí* (clarified butter) or oil, as the ordinary garden produce , such as radishes, onions, carrots, turnips, and the legumes of various plants and which are known generically as *tarkári* ; and (3) the leaves and stems of various herbaceous plants, cultivated and wild, which are boiled in water and form what is known as *ság* or greens and when cooked merely with sufficient water to prevent their burning, *bhangi* or *bhangiya.* The first class comprises a great proportion of the food of all classes during the months that they are in season and form one of the most important dietetical products of native horticulture. The second class forms the staple of curries eaten with split pulse or *dál* and the third class includes both plants specially cultivated as greens ; the leaves and parts of plants cultivated for seed, fruit or fibre, but not specially cultivated for greens, and the roots, bark, leaves, and flowers of an immense number of wild plants which are edible, and form a substitute for the cultivated plants with the poorer classes and with all, indeed, in times of scarcity. We shall divide the vegetables therefore into gourds, ordinary vegetables ; thirdly, those plants that are cultivated as greens ; and lastly, the principal wild plants that are considered edible and form a portion of the food of the people.

GOURDS.[1]

Gourds belong to the natural order *Cucurbitaceæ*, and are grown in the hills and submontane tract. They are annuals, climbing, having clasping tendrils on the stalk, hairy, drastic, pulpy and refreshing, but apt to produce evil effects if taken in inordinate quantities. The principal species, cultivated and wild, are noted below in order to give a general view of the entire order. They may be divided for their dietetic properties into three classes :—(*a*) the pleasant tasted, with a refreshing juice, usually eaten raw like the melon and water-melon : (*b*) the other edible gourds which are either insipid or bitter, and are all cooked before being eaten and (*c*) those cultivated or used for their medicinal properties only. The principal genera represented in the Kumaun division are Trichosanthes, Luffa, Cucumis, Citrullus, Cephelandra, Bryonia, Mukia, and Zehneria.

Trichosanthes palmata, Roxb.—The *indráyan* of Kumaun and *palwal* of the plains. This species may be known from its red globose fruit which is possessed of severely drastic properties when wild, though edible under cultivation when boiled. *T. dioica*, Roxb., the *palwal* of Bijnor, is also edible. Hooker, Fl. Ind., II., 606 : Drury, (F. P.), I., 467 ; Roxburgh, 695.

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[1] For a botanical description of each plant see my 'Notes on the Economic Products of the North-Western Provinces,' Part V.

Trichosanthes anguina, Linn.—Common snake gourd.—The *chachinda* of Kumaun and *chachinga* of Rohilkhand. This species is cultivated throughout the hills and plains. The fruit is greenish white, 2′-3′ long, and is usually eaten cooked. Hooker, Fl. Ind., II., 610; Roxburgh, 694; Drury (F. P.), I., 467.

Trichosanthes cucumerina, Linn.—The *jangli-chachinda* of Kumaun. The *jangli-chachinda* appears to be the wild representative of the preceding; the fruit is chiefly used in medicine, though it is edible. Hooker, *l. c.*, 609; Roxburgh, 694; Drury (U.P.), 440; Royle, 219.

Luffa ægyptiaca, Mill.—*Ghiya taroi* or *ghiya tori*. It may be known by its 5-angled leaves and 10-angled fruit. It is used much in curries, dressed as a vegetable with clarified butter and spices. Hooker, *l. c.*, 614; Roxburgh, 698; Drury (F. P.), I., 459.

Luffa acutangula, Roxb.—*Káli taroi* or *tori*. It has the lower leaves 5-angled, the upper leaves palmate, the seeds black and irregularly pitted and the fruit usually smaller and is commonly cultivated and highly valued as a vegetable. Hooker, *l. c.*, 615; Roxburgh, 698; Drury (U.P.), 291.

Lagenaria vulgaris, Sering.—Pumpkin or bottle gourd—*Lauka, tumri* (small variety), *gol kaddu*. It is from this gourd that the bottle carried by mendicants is made; it is extensively cultivated along the foot of the hills. The pulp is eaten with vinegar or mixed with rice as a *chhachhi* or vegetable curry. Hooker, *l. c.*, 613; Drury (U.P.), 383; Roxburgh, 700. This fine species was brought to Almora from Jabalpur in 1846 by the Bengal Artillery. The *tumri* variety is not edible.

Benincasa cerifera, Savi.—White gourd melon—*Bhúnja, petha, chál-kumhra*. Cultivated for its fruit, which is used in curries and as a vegetable. Fruit 1-1½ feet, cylindric, without ribs, hairy, ultimately covered with a waxy bloom. Hooker, *l. c.*, 616; Drury (U.P.), 76; Roxburgh, 700.

Momordica Charantia, Linn.—*Karela, karola*. There are two varieties well marked; the one with longer and more oblong fruit, and the other with fruit smaller, more ovated muricated and tuberceled and numerous gradations between them. The fruit is steeped in water with a little salt and then eaten cooked in curries. Hooker, *l. c.*, 616 : Drury (U.P.), 306 ; Roxburgh, 696.

Momordica dioica, Roxb.—*Gol kánkra.* There are several varieties, of which the unripe fruit and tuberous roots form an article of food. *M. Balsamina* also occurs along the foot of the hills in wild state and in Bijnor. Hooker, Fl. Ind., II., 617 ; Drury (U.P.), *306 ;* Roxburgh, *696.*

Cucumis trigonus, Roxb.—*Bislombhi.* Found wild along the foot of the hills. Hooker, *l. c.*, 619 ; Roxburgh, 701.

Cucumis Melo, Linn.—Melon—*Kharbúz*, and *C.* var. *utillisimus*, *kakri.* Both these varieties may be seen at Srinagar, but they are not cultivated in the hills generally or in the submontane tract. Hooker, *l. c.*, 620; Drury (U.P.), 172; Roxburgh, 701.

Cucumis sativus, Linn.—Cucumber—*Khíra, khírai, kakura.* This species is also cultivated for its fruit, and *C. Hardwickii*, Royle, the *air-álu* of Kumaun and *pahári-indráyan* of the plains seems to be only a variety of it. Both the latter and *C. himalensis* occur wild in the hills and Bhábar. *C. Momordica*, Roxb. (700), seems also to be a variety ; it is the *kachra* (unripe) and *phúnt* or *túti* (ripe) of the submontane tract ; names given from the fruit bursting when ripe, and is frequently cultivated. Hooker, *l. o.*, 620 ; Drury (U.P.), 173 ; Roxburgh, 700.

Citrullus Colocynthis, Schrad.—Colocynth gourd—*Indráyan* of the plains. Found along the foot of the hills ; only used in medicine. Hooker, *l. c.*, 620; Drury (U.P.), 185; Roxburgh, 700.

Citrullus vulgaris, Schrad.—Water-melon—*Tarbhúj, hindwána.* It is very sparsely cultivated in the Bhábar, and still more rarely in the hills. The seeds are eaten parched with other grain. The bitter variety is the *C. amarus* of authors. Hooker, *l. c.*, 621 ; Drury (U.P.), 174 ; Roxburgh, 700.

Cephalandra indica, Naudin.—*Bimba, kanderi ki bel.* It occurs wild, but is occasionally cultivated in the submontane tract, and the ripe fruit is eaten raw or cooked. Hooker, *l. c.*, 621 ; Drury, (U.P.) 144 ; Roxburgh, 696.

Cucurbita maxima, Duch.—Squash gourd.—*Kaddu, mítha kaddu, gaduwa.* It is frequently cultivated for its fruit which is eaten boiled: the seeds also yield a mild oil used in cooking and burning. Hooker, *l. c.*, 622 ; Drury (U.P.), 175 ; Aitch., 64.

Cucurbita moschata, Duch.—Musk-melon—*Kumhra.* It is cultivated below the hills for its fruit, which is esteemed highly palatable and nutritious. Hooker, Fl. Ind., II., 622; Roxburgh, 700.

Cucurbita Pepo, D.C.—Pumpkin or white gourd—*Kumhra, kondha, lauka,* and *kaddu-safed.* It is cultivated for its fruit. Hooker, *l. c.*, 622 ; Roxburgh, 700.

Bryonia laciniosa, Linn. It is found wild and is only used in medicine; the seeds also yield a medicinal oil. Hooker, *l. c.*, 623 ; Drury (U.P.), 87; Roxburgh, 703.

Mukia scabrella, Arn.—*Gwála-kakri.* It occurs wild and is only used in medicine. Hooker, *l. c.*, 623 ; Drury (U.P.), 88 ; Roxburgh, 702. *Zehneria umbellata,* Th., known under the same vernacular name, and its variety *Z. nepalensis,* occur wild in Kumaun.

VEGETABLES.[1]

Brassica Rapa, Linn.—Turnip—*Shalgam ;* the *chankan* of the Bhotiya parganahs. The turnip is beginning to form an article of food. The Brahmans and Baniyas of the plains have a prejudice against the turnip and carrot as in some manner resembling flesh, which is forbidden as food for them. Hooker, Fl. Ind., I., 156 ; Roxburgh, 497.

Raphanus sativus, Linn.—Radish—*Múli.* Both the long radish and the turnip-shaped radish are now largely cultivated and consumed.

Hooker, *l. c.*, 166 ; Roxburgh, 500.

Lepidium sativum, Linn.—Cress—*Hálim, hálang.* Hooker, *l. c.*, 159 ; Roxburgh, 497.

Hibiscus esculentus, Linn.—*Bhindi.* This and *H. sabdariffa* are cultivated in gardens below the hills and are consumed by all classes. Hooker, *l. c.*, 343 ; Roxburgh, 529.

Canavalia ensiformis, D. C.—Bean—*Sem.* Consumed by all classes. Hooker, *l. c.*, II., 195 ; Roxburgh, 559.

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[1] For a botanical description of each plant see my 'Notes on the Economic Products of the North-Western Provinces,' Part V.

Apium graveolens. Linn.—Celery—*Saleri.* Grown for Europeans. Hooker, *l. c.*, II., *679* ; Roxburgh, *273.*

Daucus Carota, Linn.—Carrot—*Gájar*. Hooker, *l. c.*, II., 718 ; *Roxburgh, 270.*

Lactuca sativa D. C.—Lettuce—*Kahu.* Roxburgh, 593.

Mentha viridis. Linn.—Spear mint—*Pahári-pudína.*

Salvia plebeia, R. Br.—Sage—*Salbia.* Drury (F. P.), II., 552.

Lycopersicum esculentum, Don.—Tomato—*Wiláyati baigan.* Roxburgh, 190.

Batatas edulis, Choisy.—Sweet potato—*Shakrkand, pindálu.* It is grown in the submontane tract and is a favourite with all classes. Drury (U. P.), 70 ; Roxburgh, 162.

Solanum esculentum. Linn.—Egg, plant—*Baigan* (Kumaun), *bhatta* (Garhwál). It is grown commonly by natives and Europeans. Drury (U P.), *409* ; *Roxburgh, 190.*

Solanum tuberosum, Linn.—Potato—*Alu.* The potato was introduced into Kumaun in 1843 by Major Welchman and now forms an important article of export. The seed is from time to time renewed by fresh importations.

Beta vulgaris, Linn.—Beet—*Chaukandar*. This root is chiefly grown in English gardens. Var. *bengalensis*, Roxburgh, 1, *pálang*, is cultivated as a pot-herb.

Dioscorea globosa, Roxburgh.—Yam—*Chúpri alu.* This yam is cultivated, whilst the following species found wild, furnish edible tubers :—

D. sagittata, Royle.—*Tair tarur*, the tubers lie 3-6 feet deep in the soil, edible.

D. quinata—*Magiya* or *muniya* ; white tubers, edible.

D. versicolor.—*Genthi, gajír, ganjíra* ; yields a deliciously fragrant yam, edible.

D. pentaphylla.—*Tegúna, takuli* ; tubers edible. Drury (F. P.), III., 276.

D. deltoides.—*Gun* ; on Siyáhi Devi.

Allium Cepa, Linn.—Onion—*Piyáj.* The onion is commonly cultivated, but is objected to by Brahmans and Baniyas in the plains from its having some fancied resemblance to flesh. Chives, leeks, and shallots are cultivated in European gardens.

Maranta arundinacea, Linn.—Arrow-root. This useful plant has been successfully cultivated by Mr. Fraser at Haldwáni in the Bhábar, and has yielded produce equalling the best West Indian.

Amorphophallus campanulatus, Blume.—*Zamin kand.* This sweet potato is grown in small quantities at the foot of the hills. It yields a large root stock, the size of a Swedish turnip, but flatter, and is the only one of the family that keeps well in the ground. It ripens too áfter the rest.

Colocasia antiquorum, Schott.—*Ghuiya, Ghwiya; arui* (plains). Cultivated along the foot of the hills.

Colocasia himalensis, Royle.—*Ghuiya* (plains), *pindálu* (white variety), *gaderi* (red variety), *pápar* (leaf), *guba* (unrolled leaf), all of which are edible. Other wild species are *Remusatia vivipara*, the *bágh-pindálu*, and *R. capillifera*, the *bánj-pindálu*; the former occurs 3-4,500 feet, and the latter 5-8,000 feet, flowering in June.

C.—SPICES AND CONDIMENTS.[1]

There is no country in the world, perhaps, where spices and condiments enter so largely into the food materials of the population. The man must be very poor indeed who cannot afford something of this kind with his daily meals. Much of the spices consumed are, however, imported, such as mace, cloves, black pepper, assafœtida, Ceylon cinnamon and nutmegs. The bark and leaves of *Cinnamomum Tamala* form an important flavouring material for curries, and the former is used generally as a substitute for true cinnamon. From the Himálaya, also we have turmeric, ginger, red pepper, cumin and cardamoms of excellent quality and divers wild herbs used as condiments.

The principal plants yielding spices or condiments cultivated or occurring wild in Kumaon are as follows :—

Papaver somniferum, Linn.—Poppy—*Khash-khash* (seeds). The seeds are used in curries; cultivated.

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[1] A full description of each will be found in my 'Notes on the Economic Products of the North-Western Provinces,' Part V.

Peucedanum graveolens, Benth.—Dill—*Soya.* The seeds are used in curries; cultivated. Hooker, Fl. Ind., II., 709; Roxburgh, 272; Pharm. 101.

Murraya Kœnigii, Spreng.—*Gándla, gani* (Kumaun), *gandela* or *gúndi* (Bijnor). The leaves are used for flavouring curries; the tree occurs wild in the lower hills and Bhábar. Hooker, *l. c.*, I., 503; Brandis, 48; Roxburgh, 362.

Carum Carui, Linn.—Caraway—*Jíra.* Cultivated for its seed in Garhwál, where it also occurs wild. Hooker, *l. c.*, II., 680; Pharm., 98.

Carum Roxburghianum, Benth—*Ajmúd.* Cultivated for its aromatic seeds, below the hills. Hooker, *l. c.*, 682; Roxburgh, 273.

Carum copticum, Benth.—Lovage—*Ajwáin.* Cultivated for its seeds below the hills. Hooker, *l. c.*, 682; Roxburgh, 357; Pharm., 99.

Coriandrum sativum, Linn.—Coriander—*Dhaniya.* Cultivavated for its seeds. Hooker, *l. c.*, 717; Roxburgh, 272.

Cuminum Cyminum, Linn.—Cumin—*Jíra.* Believed to be cultivated for its seeds below the hills (?). Hooker, *l. c.*, 717; Roxburgh, 271.

Fœniculum vulgare, Gœrtn.—Indian fennel—*Sonf.* Cultivated for its seed. Hooker, *l. c.*, 695; Roxburgh, 272.

Capsicum frutescens, Linn.—Red pepper—*Lál mircha, kursáni.* Cultivated for its fruit and exported. There are several species cultivated, for which see Roxburgh, 193.

Piper silvaticum, Linn.—Long pepper—*Pípala mor.*

Occurs wild in the valleys and the Bhábar and yields a substitute for the pepper of commerce. The average annual export from the Kumaun Forest Division is about 22 tons. Roxburgh, 52; Drury (U.P.), 131.

Cinnamomum Tamala, Var., *albiflorum,* Nees.—*Taj, jangli dálchini* (bark), *kikra, kirkiriya, tej-pát* (leaves).

A common shrub in Kumaun belonging to the natural order *Lauraceæ,* of which the bark and leaves are exported for culinary purposes and for use in medicinal preparations. The average annual export of the bark of this tree from the Kumaun forest division alone amounts to 25 tons, and of the leaves to 35 tons.

Curcuma longa, Roxb.—Turmeric—*Haldi, kachúr.*

This is the well-known *haldi,* so much used as a condiment. It is grown in large quantities in south-eastern Garhwál and Kumaun and in parts of Dehra Dún. It forms one of the most important and most profitable of exports from the lower hills, and is cultivated in jungles where nothing else can be profitably raised, as well as in the Dúns and Bhábar. It is singularly free from the attacks of wild animals. The tubers are planted in April-May, and the produce is gathered in November. Major Garstin has estimated the cost of cultivating one acre of turmeric at Rs. 36, of which one rupee goes for rent, Rs. 5 for sowing, Rs. 3 for planting out, Rs. 20 for seed, Rs. 4½ for weeding and hoeing, and Rs. 2½ for harvesting. An acre will produce thirty maunds of root worth Rs. 60, and when cured and dried, weighing about 7½ maunds, worth Rs. 75. Setting down the cost of curing and drying at Rs. 8, the average net profits on an acre of turmeric amounts to Rs. 31, and thus justifies its popularity amongst the hill cultivators. *C. angustifolia* is found wild.

Zingiber officinale, Ross.—Ginger—*Ada* (plant), *sonth* (green root), *adrak* (dried root).

Extensively grown in all hot valleys in Kumaun as an article of export. The mode of cultivation consists in first selecting a piece of ground not liable to be flooded and protecting it from excessive rainfall by digging a trench around the upper side. This is then well hoed and richly manured, and in Chait the ginger is planted out in trenches about half a foot deep with one foot space between each trench and between each plant. The earth is then heaped over the trenches and the whole covered over with leaves, which are kept in their places by bamboo or wooden poles. The poles are removed before the rains, but the leaves are not disturbed until the ginger crop is dug up and all the weeding is done by hand. *Z. elatum* (*kachúr*) is found wild in the Kota Dún and is a favourite food of the porcupine and wild hog. It is dug up in February all along the foot of the mountains and sent for sale to the plains, where it comes into use as a medicine.

Amomum subulatum, Roxb.—Cardamom—*Iláchi.* Cultivated in gardens for its fruit. Roxburgh, 15.

Allium sativum, Linn.—Garlic—*Lahsan.* Cultivated for its bulb.

Humulus Lupulus, Linn.—Hop. The hop flowers well at Háwalbágh, though not so successful as in the west: introduced.

D.—GREENS.[1]

The vegetable products used as greens may be conveniently divided into three classes :—

1. Plants specially cultivated for food as greens, such as the *cabbage, pálaks,* &c.
2. Products collected from plants cultivated for other purposes, such as the mustard and gram.
3. Uncultivated products used as food.

Greens are prepared for food in much water and are then pressed to get rid of the excess moisture and are seasoned with spices and clarified butter and in this form are called *ság.* When cooked in a moderate quantity of water, which leaves then crisp and dry, they are called *bhangiya.* In either form they are, as a rule, insipid and utterly unpalatable to European tastes. They are seldom eaten alone and are usually combined with cereals, pulses or other vegetables.

1.—*Plants specially cultivated as greens.*

Brassica oleracea, Linn.—The cabbage.—*Gobi.* Its cultivated varieties, the cauliflower (*phúl-gobi*), white-cabbage, Savoy, Brussels' sprouts, borecole, broccoli, and knol-kohl are all cultivated in English gardens and are gradually spreading amongst the natives. Hooker, Fl. Ind., I., 156.

Brassica juncea, H. *f et* T.—Mustard—*Rái, sarson.* The variety *S. ramosa,* Roxb., is the *banlái* of Kumaun, and the variety *S. rugosa,* Roxb., is the *bádsháhi-lái* and *bhotiya-lái* of Kumaun, introduced by the Gorkhális from Nepál. Both of these are cultivated and highly valued as a vegetable. Hooker, *l.c.*, 157.

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[1] Full description of all these plants will be found in my 'Notes on the Economic Products of the North-Western Provinces,' Part V., Allahabad, 1881.

Eruca sativa, Lam., is the *dúa* and *chára* of Kumaun. Cultivated as a fodder and for the oil expressed from its seeds. Hooker, *l. c.*, 158.

Nasturtium officinale, Brown.—Water-cress—*Piriya-hálim.* It occurs cultivated and wild in the Kota and Dehra Dún. Hooker, *l. c.*, II., 133.

Lepidium sativum, Linn.—Cress—*Hálim hálang* (Garhwál). Commonly cultivated as a relish. Hooker, *l. c.*, I., 159.

Trigonella Fænum-græcum, Linn.—Fenugreek—*Methi.* Cultivated; cooked either alone as a relish or with unleavened bread (*roti*). Hooker, Fl. Ind., II., 87.

Oxalis corniculata, Linn.—*Chalmori.* Occasionally cultivated, usually wild; used as a salad. Hooker, *l. c.*, I., 436.

Portulaca oleracea, Linn.—Small purslain—*Lúnak.* Cultivated everywhere. Green leaves cooked or eaten as a salad. Hooker, *l. c.*, I., 246.

Amaranthus Blitum, Linn.—*Chaulái.* This and other species of amaranth, such as *A. gangeticus* and its variety *A. oleraceus*, are chiefly used as pot-herbs. Roxburgh, 641.

Ocimum Basilicum, Linn.—Sweet basil—*Káli túlsi.* Cultivated as a flavouring pot-herb. Roxburgh, 463.

Chenopodium album, Linn.—*Bethuwa, charái.* This and *C. viride* are used as greens and are very popular.

Phytolacca acinosa, Roxb.—*Jirrag.* Cultivated up to 10,000 feet for its leaves, which are used as greens. Roxburgh, 389.

Basella rubra, Willd.—*Pái.* Cultivated as greens. Roxburgh, 275.

Rumex vesicarius, Linn.—*Chúka-pálang.* Cultivated in beds near wells. Roxburgh, 309.

Perilla ocimoides, Linn.—*Bhangara.* Cultivated both for its leaves and for the culinary oil expressed from the seeds.

2.—*Products collected from plants cultivated for other purposes.*

Under this head the following may be briefly noticed. The leaves of the coriander, *Coriandrum sativum.*, Linn, the *dhaniya* of he hills and plains, are collected as greens, the plant itself being cultivated for its aromatic seeds. Similarly the leaves of the gram plant, *Cicer arietinum*, Linn., and buckwheat are used as a spinach, as well as those of the safflower, *Carthamus tinctorius*, Linn. The leaves of most of the pulses, such as *lobiya*, *sem*, &c., grown for their seeds, are eaten; also of *Brassica campestris* and *Perilla ocimoides*, cultivated for their oil-seeds; of the different species of *Arum* grown for their tubers, and of *Hibiscus cannabinus*, Linn., cultivated for its fibre. In times of scarcity there are few products of the vegetable kingdom which are not absolutely hurtful that do not afford some aid to the poor man's table. The next section gives a long list of those wild fruits, berries, and leaves that are thus brought under requisition, whilst the number of trees whose foliage affords fodder for cattle when the drought dries up the grass is hardly smaller. The value of the forests, therefore, in times of scarcity is considerable, and it is then that the hungry pour into them from every district in the plains, and try to eke out a miserable existence by collecting these berries and leaves.

E.—FRUITS, CULTIVATED AND WILD.

The cultivated fruits of the Kumaun division include the peach, apricot, plum, damson, cherry, apple, pear, quince, medlar, orange, lemon, lime, citron, walnut, mango, guava, plantain, pomegranate, fig, strawberry, and mulberry: a goodly list, but varying muchni quality. Most of the European fruit trees have been introduced and distributed from the plantations formed in recent years at Mussooree, Chhajauri, Páori, Háwalbágh, and Ránikhet. Amongst the wild fruits may be noticed the gooseberry, red and black currant, blackberry, hazel-nut, raspberry, strawberry, figs, pears, apples, and walnuts, none of which are of much value. Wild rhubarb of the red species grows in large quantities in the upper ranges above 9,000 feet and is of good flavour. In the following section will be found a short notice of the more valuable species and a list of the wild fruits that are commonly regarded as edible and in some respects afford a food resource, especially in seasons of scarcity. In each case a reference is given to a full botanical description from which the tree or plant may be recognized.

Citrus medica, Linn.—Citron. Brandis, p. 50.

Brandis refers the citron, lime, and lemon as varieties of this species.

I.—*medica* proper—Citron. To this belongs the wild varieties known as *bijaura* and *karan-phal* found in the Bhábar and along the Sarju under Gangoli Hát in Kumaun. The wild varieties are used for pickling and the dried rind is made into a preserve. The cultivated variety yields the well-known citron preserve; and to it belongs the *madkakari* of Garhwál.

II.—*Limonum*—Lemon. Madden refers to this variety the *jámíra* found wild in the Kota Dún of Kumaun, and Royle notes one called *pahári-nímbu* or *pahári-kághazi* as wild in the Dehra Dún and the north-western Himálaya. Madden states that the lemons produced in and around Almora in the cold season and allowed to mature in straw are of excellent quality.

III.—*acida*—Sour-lime. This includes the *nîbu* and its cultivated varieties, the *kághazi*, &c. They are much employed for sherbets and the like and thrive well in the warm valleys.

IV.—*Limetta.*—Sweet-lime. This variety is cultivated in suitable localities in Kumaun under the names *amrit-phal, mitha-nîbu.* It ripens as far north as the valley of the Sarju near Bágeswar and is much used for sherbets. The dried rind is in request as a flavouring agent.

Citrus decumana, Linn.—Shaddock, pumelo. Brandis, p. 55. This species was introduced into India from Java and is now completely naturalised, ripening in the hills as far as Háwalbágh, near Almora, under the names *saddáphal, mahá-nîbu.* It is a great favourite with all classes and gives fruit all the year round, so that on one tree may be seen the flower and ripe and unripe fruit at the same time.

Citrus aurantium, Linn., includes the bitter or Seville orange, the sweet orange and the bergamot. Brandis, p. 50. Of these three varieties the sweet orange is the form most commonly cultivated. There are several local varieties, some named after the localities in which they are produced and others according to specific distinctions in size or flavour. The *kaunla* is the smallest and most esteemed, and of it the best cultivated varieties are found in the warm valleys of eastern Kumaun. Oranges are now cultivated generally throughout the hills up to 5,500 feet and some excellent varieties thrive at Bamti in Garhwál. The orange has been found wild or apparently wild with unwinged petioles at Bágeswar in Kumaun (Str. and W.) and with globose fruit, naked or margined petioles and oblong-lanceolate, acuminate leaves in Garhwál (T. T.)

Vitis vinifera, Linn.—The vine. Brandis, 98. The fruit is called *dákhang* in Kunáor, where it flourishes ; but it can be raised in Kumaun, where the rains are not too heavy. The vines and apricots of Kunáor are much praised in the Puránas.

Mangifera indica, Linn.—Mango—*Am.* Hooker, II., 14. The mango is said to occur wild in the sub-Himálayan tract from Kumaun to Sikkim, but it is also cultivated in the Dúns. The mango groves of the Kota Dún have more than a local repute.

Prunus Amygdalus, Baill.—Almond—*Badám.* Hooker, II., 312. A few trees are cultivated in Kumaun, introduced probably by Aoghání workmen.

Prunus persica, B. et H. *f.*—Peach—*Aru, rek.* Hooker, II., 313. The usual English varieties have been imported and thrive well in suitable localities. The Kábuli peach is completely naturalised in the north-western Himálaya and in places appears to grow wild. Brandis has some observations (p. 191) on its distribution, and notes that the blossom is apt to be killed by excessive frost and that a small green beetle, at times, strips the tree of its leaves. Madden states that at Almora the fruit does not ripen well nor does it ripen at Naini Tál, but in the Dehra Dún and the warmer valleys it comes to perfection and bears well. The flowers appear in January-May, and the fruit ripens in May-October, according to locality.

Prunus Armeniaca, Linn.—Apricot—*Chúáru, chola, zard-álu, jald-áru, kushm-áru,* the *galdam* of Tibet. Hooker, II., 313.

The apricot is commonly cultivated all over the hills, especially to the west, in the valleys of the Jumna and Tons, where it affords a very important local food resource and an article of export. An oil is there extracted from the kernels and is used in medicine and for perfumery purposes for the hair and for burning. This oil is clear, of a pale yellow colour and smells strongly of hydrocyanic acid, of which it often contains four parts in 100. Several European varieties have been introduced and distributed through the Ránikhet nad

Mussooree nurseries. The flowers appear in January-May, according to elevation, and the fruit ripens in May-September.

Prunus Avium, Linn.—Sweet cherry or gean—*Gilás.* Hooker, II., 313. Brandis unites this and the following and Hooker keeps them separate. This species is cultivated to the west up to 8,000 feet. It flowers in April-May and the fruit ripens in June. The European varieties introduced have not succeeded in these hills, owing to the effect of the heavy rain on the young fruit.

Prunus Cerasus, Linn.—Acid cherry—*Alu-bhálu.* Hooker, II. 313. Cultivated up to 7,000 feet. Several varieties from European stock have been introduced and thrive where the rain is not excessive. It flowers and fruits at the same time as the preceding.

Prunus Puddum, Roxb.—Wild cherry—*Páya, paiya, padam, paddam.* Hooker, II., 315. Common, both wild and half cultivated all over the hills of these provinces. The fruit, though very bitter, is eaten by the natives and is collected for Europeans to make the well-known hill cherry brandy. The flowers appear in October-November and the fruit ripens in spring.

Prunus communis, Huds.—Yellow bullace—*Alu-bukhára* (blue), *alecha, alúcha* (yellow), *chhota álu* (small variety). Hooker, II., 315. Madden notes two cultivated varieties at Almora; one a dark-blue damson known as *bhotiya-baddm,* and the other a larger orange red variety called *ladák.* The first ripens in July and the second in June, and both may probably be referred to *P. communis,* var. *domestica,* plum or prune. Madden styles them "palatable, but unwholesome." Brandis unites (p. 192) under this species the sloe and the different kinds of plums, damsons, and prunes. Many European varieties have been introduced with more or less success.

Prunus Padus, Linn.—Bird-cherry—*Jámana.* Hooker, II., 316. This species occurs wild 4,000 to 10,000 feet. The fruit, though insipid and somewhat astringent, is eaten by the natives and may be used in the manufacture of liqueurs. The flowers appear in the hot season, the fruit in the rains. Other wild species are (1) *P. nepalensis,* Ser., which differs from *P. Padus* by having the fruit twice as large with a quite smooth, thick-walled stone. (2) *P. Jaceuqmontii,* Hook. *f.,* recorded from the Dhauli valley in Garhwál.

(3) *P. undulata*, Ham., which occurs from the Jumna to Bhután at 6,500-8,000 feet, but none of them have any economical value.

Fragaria vesca, Linn.—Strawberry. Hooker, II., 343. The strawberry grows very well in the hills at Mussooree, Binsar, Ráni-*khet, Naini Tál, and on most tea plantations. Imported stocks* also thrive, and indeed experience shows that the local stock should be renewed every three years and, when possible, from cuttings from other gardens. The wild strawberries (*Fragaria indica*, Andr.—*Kipaliya, bhyúla* and *F. Vesca*, var. *nubicola*) yield abundantly a palatable fruit, which, however, can be wonderfully improved by cultivation. The fruit of the cultivated species ripens in the hills during April-May.

Cydonia vulgaris, Pers.—Quince—*Bihi.* Hooker, II., 368. The quince is cultivated in the hills up to 5,500 feet and is eaten fresh, candied, dried or in tarts. The fruit ripens June-July. Several European varieties have been introduced through the public nurseries and by private growers.

Pyrus communis, Linn.—Pear—*Náspati, nák.* Hooker, II., 374. The pear is cultivated for its fruit throughout the hills 2-8,500 feet. Most of the European varieties flourish in Kumaun, and pears of excellent quality from Jalna near Almora and other gardens are now procurable in the Naini Tál market. The tree flowers in the spring and the fruit ripens during the rains.

Pyrus Pashia, Ham.—*Mehal, mol.* Hooker, II., 374. This species occurs wild everywhere in the hills 2,500-8,000 feet. The fruit is hard, bitter and worthless, and is only eatable when half-rotten. The stocks are good for grafting. The flowers appear in the spring and the fruit ripens in September-December.

Pyrus Malus, Linn.—Apple—*Seb, seo.* Hooker, II., 373. The apple occurs wild in the hills 5,000-9,000 feet and is also cultivated. The flowers appear in the spring and the fruit ripens July-September. Much has been done of late years to promote pomiculture by the distribution of grafts of introduced species from the public nurseries. *Apples of all varieties are now found in the* markets of excellent quality and at a reasonable price.

Pyrus baccata, Linn.—Siberian crab—*Ban-mehal, gwálu-mehal.* Hooker, II., 373. This species occurs wild 6-11,000 feet.

The fruit is small and sour, but is much prized by the natives. H. Strachey found it at Kunti in Byáns of Kumaun bearing a very small red crab no bigger than a wild cherry and worthless to eat. The flowers appear in spring and the fruit ripens towards the end of the rains.

Pyrus lanata, Don.—*Galion, mehali, pattu, ban-patti.* Hooker, II., 375. This species is also wild and is not uncommon 5-10,000 feet. Like the fruit of *P. Pashia,* the fruit of this tree is only eatable when half-rotten. The flowers appear in April-May and the fruit ripens in August-October. There are several other wild species occurring in Kumaun, such as (1) *P. kumaoni,* Decaisne, 5-8,000 feet; (2) *P. vestita,* Wall., known as *mauli* and one of the best (sweetest) wild fruits; and (3) *P. foliolosa,* Wall., known as *háliya-sáliya.* None of these, except *P. vestita,* yield a fruit of any value, nor is it recorded whether the stocks can be utilised for grafting. All have been described by Hooker.

Ribes Grossularia, Linn.—Gooseberry—*Lepcha, galdam* (Byáns), *sirgochi* (Juhár). Hooker, II., 410. The wild gooseberry occurs in the dry parts of the inner Himálaya, 8-11,500 feet. The flowers appear in spring and the fruit ripens in September-October. It has a sour taste and is small and not eatable. H. Strachey records having found it at Tála-káwa in Byans in September and pronounces it worthless. The European cultivated varieties have been introduced, but do not thrive nor bear freely.

Ribes glaciale, Wall.—Black and red currant—*Kukuliya, kala-káliya mángle* (Byáns), the red variety; *durbui, dongole* (Byáns), the black variety. Hooker, II., 410. The red variety occurs rarely, but the black is frequent above 10,000 feet in Kumaun. The latter is the *R. acuminatum* of Wallich. Both yield a sour, unpalatable fruit of no value. H. Strachey found it near Nabhi in Byáns, where it is very abundant and yields a fruit described by him as "small and insipid." The flowers appear in May and the fruit ripens in September-October.

Ribes nigrum, Linn.—Black currant.—*Pápar.* Hooker, II., 411. This species occurs towards the heads of the Tons and Jumna and in Kumaun on the northern slopes of Rigari-Gudari (G.) over 10,000 feet. The flowers appear in July and the fruit ripens in

August-September. Major Garstin states that the fruit is quite as large and as palatable as the cultivated variety.

Ribes rubrum, Linn.—Red currant—*Pápar*. Hooker, II., 411. This species occurs in both moist and arid tracts along the inner Himálaya, 5,000-12,000 feet. Brandis notes that in Lahúl there are specimens with a deep campanulate calyx, the lobes of which are ciliate and the fruit (*niangha*) is yellow when unripe, but black when ripe with the taste of red currants. This fruit is altogether better than that of *R. glaciale* above, though small and more acid than is agreeable. The cultivated red, white, and black currants have been introduced from Europe, but do not appear to succeed in the Kumaun climate.

Punica Granatum, Linn.—Pomegranate—*Anár dárim* (tree and fruit), *náshphál, kushiála, post-anár* (rind). Hooker, II., 580. The pomegranate occurs wild all over the hills. The flowers (red or yellow) appear in April-May and the fruit ripens in July-September. There are several varieties cultivated, the flowering pomegranate and those with sweet or acid fruit, but those raised from Afghánistán stocks are preferred. The fruit is sub-acid and pleasant to the taste and allays thirst. The bark is largely exported for tanning.

Bassia butyracea, Roxb.—Butter-tree—*Chiúra*, *chyúra;* the butter is called *chyúra-ka-pina* in Almora and *phalel* and *phalwára* in the plains. Brandis, 290; As. Res., VIII., 477. This fine tree occurs along the outer ranges 1,500-4,000 feet. The flowers appear from November to January, and the honey produced by the bees that feed on them is esteemed above all others in Kumaun. Madden records its occurrence on the Kamolaghát leading to the Kota Dún. In Sor, it is abundant in the Pithoragarh valley, reaching the size of a large tree as high up as Kanthagaon (4,000 feet), and it occurs in abundance in the Káli valley on both the Kumaun and Nepál sides, from Askot to Punagiri, near Barmdeo. The sweet insipid pulp of the fruit is eaten and the cake left after the oil has been extracted is eatable. From the seeds a soft solid vegetable butter is extracted of the consistence of fine lard and of a delicate white colour, which does not melt in the heat of the plains and keeps a long time without deteriorating. It melts completely at 120°F., and is used as a cold-cream and lip-salve. Pharm., 131.

Corylus Colurna, Linn—Hazel—*Kapási, Bhotiya-badám.* The hazel occurs wild 5,000-10,000 feet to the west of the Ganges and in one strip of jungle in Painkhanda, nine miles north-east of Joshimath and in a few other places in Garhwál. The flowers appear in March-April and the fruit ripens in the rains. The kernels of the fruit are eaten and in some places are as good as English hazel-nuts. The trees bear every third year and yield a crop sufficient for export to the plains.

Juglans regia, Linn.—Walnut—*Akhrot, kharot, ák.* Brandis, 497. This tree occurs wild and planted throughout the hills. The fruit ripens in July-September and numbers several varieties, the best being the thin-shelled or *kághazi-akhrot*. The better sorts appear to be more common to the west of the Ganges. An oil used for burning and culinary purposes is expressed from the kernels of both the wild and cultivated varieties.

A mere list of the remaining trees, cultivated and wild, that afford edible products will be sufficient. A description of each tree will be found in Part V. of my 'Notes on the Economic Products of the North-Western Provinces.'

Scientific name.	Vernacular name.	Reference.	Portions edible.
Dillenia indica ...	*Chalta, chalita* ...	Hooker, I., 30 ..	Buds, calyx, leaves and fruit.
Anona squamosa ...	*Behe* ...	" 78 ..	Fruit (Barmdeo), wild.
Berberis asiatica ...	*Kilmora* ..	" 110 ...	Fruit: other species also eaten.
" aristata ...	*Chotra nachi-shu* (Bhot)	" 110 ...	Fruit often dried like raisins.
Capparis spinosa ...	*Ulta-kánta* ...	" 173 ...	Flower-buds pickled as capers; fruit.
Flacourtia Ramontchi.	*Kandi, Kandái* ..	" 193 ...	Fruit.
Flacourtia sepiaria	...	" 194 ...	Fruit.
Saurauja nepalensis,	*Gogina, gogána* ...	" 286 ..	Do.
Bombax malabaricum	*Semal* ...	" 349 ...	Calyx of flower-buds.
Sterculia urens ...	...	" 355 ...	Roasted seeds.
Grewia asiatica ...	*Dháman, pharsiya* ...	" 387 ...	Palatable sub-acid fruit.
" oppositifolia,	*Bhengál* ...	" 384 ...	Ditto
" scabrophylla,	*Gár-bhela* ...	" 387 ...	Ditto.
Elæocarpus Varunua.	*Jalpai* ...	" 407 ...	Fruit. very rare.

Scientific name.	Vernacular name.	Reference	Portions edible.
Glycosmis pentaphylla.	*Ban-nimbu pilru, potala.*	Hooker, I., 499	Fruit: very rare in Bhábar.
Limonia acidissima,	*Beli* ...	„ 507 ..	Pulp of fruit in sherbet: wild.
Feronia Elephantum.	*Kait, kath bel* ...	„ 516 ...	Fruit · cultivated and wild.
Ægle Marmelos ...	*Bel, sriphala* ..	„ 517 ..	Ditto: ditto.
Garuga pinnata ..	*Kitmira, kharpat* ...	„ 529 ...	Fleshy black drupe.
Zizyphus Jujuba ...	*Ber, bera* ...	„ 632 ..	Fruit: cultivated
„ vulgaris ...	*Kandiári, kál phal, khalis, beri.*	„ 634 ..	Ditto · cultivated and wild
„ Œnoplia ...	*Mako, bamolan* ...	„ 634 .	Ditto: wild.
„ oxyphylla ..	*Gigai* ...	„ 634 ...	Ditto: do.
Hovenia dulcis ...	...	„ 640 ...	Ditto· cultivated and wild.
Sageretia oppositifolia.	*Aglaia* ...	„ 641 ..	Black, succulent fruit.
Vitis lanata ...	*Asaujiya, pahár-phátu, purain.*	„ 651 ...	Fruit.
Æsculus indica ...	*Pánkar* ...	„ 675 ...	Seeds steeped and ground.
Pistacia integerrima,	*Kákra-singi* (fruit) ...	Hooker, II., 13 ...	Fruit.
Semecarpus Anacardium	*Bhiláwa, bhela* ...	„ 31 ..	Fleshy receptacle around seeds
Buchanania latifolia,	*Piyál, múriya, hathbhiláwa.*	„ 23 ...	Kernels of the fruit.
Spondias mangifera,	*Amra, bahamb, amára,*	„ 42 ..	Fruit.
Moringa pterygosperma	*Sahajna, sehjna* ...	„ 45 ..	Bark, leaves, flowers, pods.
Bauhinia malabarica,	*Amli* ...	„ 277 ..	Leaves
„ variegata,	*Kachnár, khairwál, bariál,*	„ 284 ..	Ditto and flower-buds.
„ purpurea .	*Kaniyár, kandan, gúriál.*	„ 284 ...	Flower-buds.
„ Vahlii ..	*Máljan, málu* ...	„ 279 ...	Seeds.
Tamarindus indica	*Imli* ...	„ 273 ..	Fruit. cultivated.
Cassia Fistula ..	*Kitwali, kitola, itola* ..	„ 261 ..	Young pods
Prinsepia utilis ..	*Bhekara, dhatela, jhatela.*	„ 322 ...	Oil of seeds.
Rubus lanatus ..	*Hisálu* ..	„ 331 ..	Fruit
„ paniculatus .	*Kála-hisálu, anchu, pathaurola.*	„ 329 ...	Black fruit.
„ moluccanus ..	*Katsol, hisalu* ...	„ 330 ...	Red fruit.
„ niveus ...	*Píla-hisálu* ...	„ 335 ...	Brownish-yellow fruit common
„ lasiocarpus ...	*Hisálu, kála,* and *lál* ...	„ 339 ...	Red and black fruit; common
„ ellipticus ...	*Gauri-phal, jogiya-hisálu.*	„ 336 ...	Yellow fruit, common.
„ nutans ..	*Langur, sinjang* (Bhot).	„ 334 ...	Red fruit.
Terminalia bellerica,	*Bahera* ...	„ 445 ...	Kernels of fruit.
Eugenia operculata,	*Rái-jáman* ...	„ 498 ...	Fruit.
Alangium Lamarckii,	*Akola, ghaul* ...	„ 741 ...	Do.
Cornus macrophylla,	*Kágshi, rúchiya* ...	„ 744 ...	Do.
„ capitata ...	*Bamaura* ...	„ 744 ...	Do.

Scientific name	Vernacular name.	Reference.	Portions edible.
Lonicera angustifolia.	*Geang* (Jaunsár) ...	Hooker, III, 13...	Fruit
Viburnum stellulatum.	*Lál ut-malya* ...	„ 4 ..	Do.
Anthocephalus Cadamba.	*Kadam* ...	„ 23...	Do., cultivated.
Randia uliginosa ...	*Pindáru* ...	„ 110 .	Do.
„ dumetorum,	*Mainphal, mangál* ...	„ 110 ..	Do.
Mæsa argentea ...	*Phasera, gogsa* ...	Brandis, 283 ...	Do.
Orthanthera viminea,	*Chapkiya* ...	„ 334 ..	Flower-buds.
Cordia Myxa ...	*Bairala, baurala* ...	„ 336 ...	Fruit.
„ vestita ...	*Pin, kúm* ...	„ 338 ..	Do.
Ehretia serrata ...	*Púna, panden.* ..	„ 339 ...	Do
„ lævis ...	*Chamror* ...	„ 340 ...	Do.
Hippophae rhamnoides.	*Dhár-chuk, tarwa-chuk.*	„ 388 ...	Do.
Elæagnus latifolia,	*Ghiwai, mijhaula* ...	„ 390 ..	Do.
Morus indica ...	*Tút túeri* ...	„ 408 ...	Do.
„ serrata ..	*Kimu, himu* ..	„ 409 ...	Do.
„ lævigata ...	*Sháh-tút, siyáh-tút* ..	„ 409 ...	Do
„ multicaulis ...	...	...	Leaves for silk-worms.
„ chinensis ...	...	...	Do
Ficus Carica ...	*Anjír* ..	„ 418 .	Fruit
„ macrophylla...	*Timla* ...	Roxburgh, 645...	Do
„ virgata ...	*Beru* ..	Brandis, 419 ...	Do
„ Cunia ...	*Kunia, kuinan* ..	„ 421 ...	Do
„ glomerata ...	*Gúlar, pauwa, lelha*...	„ 422 ...	Do.
Artocarpus Lakoocha,	*Dahu, barhal* ...	„ 426 ...	Do and male flower heads.
Celtis australis ...	*Kharak* ..	„ 428 ...	Fruit.
Antidesma diandrum,	*Amli, sarshoti, sarsheti.*	„ 447 ...	Do.
Briedelia retusa ..	*Gauli* ...	„ 449 ...	Do.
Phyllanthus Emblica,	*Aonla, amla, amlika*...	„ 454 ...	Do.
Securinega obovata,	*Gwála-dárim, dháni* ..	„ 455 ..	Do.
Myrica sapida ..	*Káiphal* ...	„ 495 ...	Do.
Ephedra vulgaris ...	*Khana* ...	„ 501 ...	Do.
Musa sapientum ...	*Kela* ...	Roxburgh, 223 ...	Do., wild and cultivated.
Dendrocalamus strictus.	*Báns* ...	Brandis, 564 ...	Tender shoots.

F.—PARTS OF WILD PLANTS USED AS FOOD IN THE HILLS OR SUBMONTANE TRACT.

The following list[1] gives some of the wild plants of which parts are used for food in seasons of scarcity. Some of them, such as the lotus, yams, and wild millets, are always eaten by the poorer classes :—

Scientific name.	Vernacular name.	Reference.	Parts edible.
Nelumbium speciosum.	*Kanwal, padam, ambaj.*	Hooker, I , 116...	Stalk, leaves, and roots
Triumfetta rhomboidea.	*Manphora, jhinjhru* ..	" 395...	Leaves and seeds.
" pilosa ...	*Leshwa-kumariya* ...	" 394 ..	Ditto.
Tribulus terrestris ..	*Gokhru* ...	" 423 ..	Leaves and fruit.
Leea aspera ...	*Kumali, kurmáli*	" 666	Fruit
Pueraria tuberosa ...	*Bilái-kand, biráli, púna, sarál* (Jaunsár).	Hooker, II , 197...	Tuberous roots
Flemingia congesta,	*Mus-kela* ...	" 229...	Pods
Cassia Tora	*Banár, panwár* ..	" 263. .	Leaves and stems.
Trianthema monogyna.	*Bishkhapra* ..	" 660...	Ditto.
Hydrocotyle asiatica.	*Thalkari* ..	" 669...	Leaves.
Ipomœa sessiliflora,	*Haran-khúri, hara* ..	Roxburgh, 159...	Ditto and stems.
Solanum verbascifolium.	*Aseda* ...	" 189...	*Fruit.*
Celosia argentea ...	*Su áli, ghogiya* ...	" 228...	Leaves and stems.
Digera arvensis ...	*Das* ..	Drury, III., 29 .	Ditto.
Euphorbia angustifolia	*Dúdhila-ghás, mahábar.*	" 120...	Seeds.
Urtica parviflora ...	*Berain, shishona* ..	Roxburgh, 654...	Leaves.
Aloe vulgaris ...	*Gaikwár* ...	Drury (U.P.)27...	Seeds and leaf pulp.
Commelyna obliqua,	*Kána, kanjura* ..	Drury (F P.)III , 310 ...	Leaves and stems.
Dioscorea sagittata,	*Tarr, tarūr* ..	Royle ...	Roots.
" versicolor,	*Genthi, githi gajir,-ghanjin.*	Drury (F.P.)III., 277 ...	Do.
" pentaphylla	*Tagúna, tákuli* ...	" 276.	
" quinata ..	*Magiya, muniya* ...	...	Do.
" deltoidea ...	*Gán* ..	...	Do.
" aculeata ...	*Man-álu* ...	276 ...	Do.
Oplismenus colonus,	*Saun, janglí-mandira,*	" 570 ...	Seeds.
Saccharum Sara ...	*Sarhar sarūr* ...	Roxburgh, 82 ...	Do. in Bhábar.
Scirpus Kysoor ..	*Kaseru* ...	" 77 ...	*Roots.*
Asplenium polypodioides.	*Lingura* ...	...	Fronds.
Nephrodium odoratum.	*Kutra* ...	...	Do.

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[1] Descriptions of all these plants will be found in Part V. of my 'Notes on the Economic Products of the North-Western Provinces,' Allahabad, 1881.

II.—VEGETABLE SUBSTANCES USED IN MEDICINE OR FOR INTOXICATION.

A.—DRUGS. B.—NARCOTICS AND SPIRIT.

A.—DRUGS.

My object in the following list of the vegetable drugs found and used in or exported from the Himálayan districts of these Provinces is to give a reference to a work where each one is botanically described and also to a work where their medicinal properties have been noticed.[1] It would be out of place here to do more than briefly indicate the therapeutic virtues attributed to them by European and Native practitioners. The following remarks[2] of Dr. Burton Brown on the vegetable drugs collected for the Lahore Exhibition will form a fitting introduction to this section of our subject:—

"The medicinal use of preparations of vegetable drugs has been for a long time of the greatest importance, and until a comparatively recent period the number of drugs obtained from plants and animals greatly exceeded that of preparations from the mineral kingdom. This depended on the fact that until chemical knowledge was fixed on a firm basis, it was only with great difficulty and after many failures that chemical products could possibly be obtained; while, on the other hand, the different parts of plants to which a medicinal use was assigned were easily distinguished and procured without much trouble. In Europe, owing to the progress of science, mineral preparations are now most extensively made and used for medicinal purposes, and many of our most valuable drugs are derived from this kingdom. But in India the knowledge of chemistry is confined to those among the natives who have been instructed by Europeans, and therefore medicinal substances procured from the mineral kingdom are comparatively seldom made or used, excepting by those who have been so taught; or those mineral articles are used which are procurable without much skill in preparation and are often of little efficacy. The use of vegetable drugs would probably be the first to recommend itself to those seeking relief from pain and disease, because plants are everywhere at hand, their number is very great, and their forms are distinctive and often peculiar, and in some cases they have been supposed to bear a more or less obscure resemblance to certain parts of the body, either in health or when diseased. Thus, in olden times, we find in Homer that Nestor used a poultice of onions, cheese, and meal, mixed with wine, to Machaon's wound; and the former substance was used by the ancient Egyptians in cases of dropsy. The hellebore of Anticyra was long extolled by the Greek writers, and is said to have been used by Melampus of Argos to cure the daughter of king Proclus of melancholy. It has also been supposed that opium was the *Nepenthe* of Homer.

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[1] A full description of each plant or tree and a more detailed notice of uses of each drug will be found in my "Notes on the Economic Products of the North-Western Provinces," Part VII. [2] Panj. Products.

" Enough has been adduced to prove the antiquity of those simples or Galenical preparations as medicinal drugs derived from the vegetable kingdom, and it is well next to consider in what manner the use of drugs was probably commenced. The use of each vegetable preparation was, probably, at first brought about by the experience of individuals, each of whom had found that certain plants were useful in the diseases which afflicted himself or his neighbours, and this knowledge was more rapidly spread owing to the ancient custom of placing the sick in public roads and markets, so that passers-by might communicate information respecting such remedies as were employed in similar cases. As observed by Herodotus, in this way a knowledge of a great number of medicines would be acquired, at first chiefly of those which were indigenous to the country, but gradually the drugs of other countries would become known, especially those which were found to be of undoubted efficacy in the disease for which they are used.

Hence it is to be expected that there will be found a larger number of substances, which are inert or nearly so in a Materia Medica which comprises indigenous plants only, than in a collection of drugs brought from a distance. Moreover, as the imported drugs must always be more costly than the indigenous ones, there will always be a tendency to substitute some indigenous substance which may resemble the foreign one in appearance or action, especially as the description of the drugs or of the plants from which they are derived was formerly much less carefully attended to than now. Thus it will be seen, as above stated, that an Indian plant, *Picrorhiza Kurrooa*, has been substituted for the more remote hellebore of the Greek physicians. Similarly a kind of *Valerian* takes the place of *Asarabacca*, and fruits of *Gardenia* that of the juniper. This substitution would certainly bring the kind of remedy in which it was employed into disrepute, as the substance used for adulteration would differ greatly from the original drug in its powers and mode of action.

"Besides the above modes of ascertaining the natures of remedies, which, being founded on actual experience, must be termed improved methods, there is another mode called the *Doctrine of signatures.* This is founded on the belief that every natural substance possessed of medicinal virtues indicates by its external character the disease for which it should be employed. Thus turmeric, rhubarb, and other roots, which have a brilliant yellow colour, were supposed to be specially useful in jaundice and diseases of the liver. *Cassia fistula* (*amaltás*), from the peculiar septa of the fruit resembling the valves of the intestines, is supposed to be especially destined for the cure of diseases of those organs; and similarly, poppies, from the shape of their capsule, were supposed to be useful in diseases of the head; and roses, from the colour of their petals, in those of the blood. Many small red or yellow seeds, especially those of cruciferous plants, were supposed to be useful in cases of gravel, the deposit of which they sometimes resemble in appearance; and *sálap misri* is used in diseases of that organ to which the name of *Orchis* (applied usually to the plant) is assigned. The convoluted pod of the *Helicteres Isora* is employed in colic, since it is supposed to resemble the twisting of the coils of the intestines. But although it is probable that the use of different drugs was commenced in some of the ways already spoken of, yet at the present day the native physicians have adopted, with some modifications, the idea of GALEN respecting the method of operation of medicines: this was, that the uses of all medicines were derived from their elementary or cardinal properties—namely, heat, cold, moisture, and dryness; and that all diseases could also be classed under the above heads, but that in the treatment of disease a medicine should always be employed which was of a contrary nature to the disease treated. Thus a cold disease requires a hot remedy and the converse. It is probable that ignorance of the attachment to this theory (which is well known to native patients and *hakims*) is often an obstacle to the employment of European medicines in the hands of European practitioners among natives, as either a remedy which they consider hot is employed for a disease which is also considered hot, or the prescriber does not state whether the remedy given is a hot or cold one even when asked. Although the theory that medicine acts by being hot or cold only is entirely erroneous, yet it has so strong a hold on the confidence of many natives that, without some attention to it, it would be difficult in many cases to induce them to take the medicine ordered.

"The following is a list of some of the drugs employed, showing their nature according to native ideas, and also their real use in European medicine :—

Scientific name.	Vernacular name.	Reference.[1]	Real use.
	Cold medicines.		
Phyllanthus Emblica, Linn.	Aonla, amlika ...	Brandis, 454 ...	Astringent and acid purgative.
Rosa centifolia, Linn.	Gúl-surkh ...	" 200 ...	Astringent and purgative.
Rosa alba, Linn. ...	Gúl-seoti ...	" 200 ...	Astringent.
Citrus Aurantium, Linn.	Nárangi ...	" 53 ...	Astingent, tonic.
Tamarindus indica, Linn.	*Imli* ...	" 163 ..	*Refrigerant.*
Terminalia Chebula, Retz.	Harera ...	" 223 ...	Astringent.
Rhus Coriaria, Linn.,	Samák ...	" 120 ...	Ditto.
	Hot medicines.		
Semecarpus Anacardium, Linn	Bhiláwa ...	Brandis, 124 ...	Acrid.
Corylus Colurna, Linn.	Findak ...	" 494 ...	Demulcent.
Zingiber officinale, Roxb.	Sonth ...	Drury, 163 ...	Aromatic.
Moschus ...	Mushk ...	...	Ditto.
Aquilaria Agallocha, Roxb.	Úd ...	Brandis, 387 ...	Tonic
Amber ...	Kahruba ...	...	Ditto.

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[1] The references are to Brandis' *Forest Flora*, Drury's *Useful Plants*, Hooker's *Flora of British India*, and the *Pharmacopœia of India*.

Scientific name.	Vernacular name.	Reference.	Real use.
	Dry medicines.		
Prunella (species) ...	Ustúkhúdús ..	...	Aromatic.
Raw silk ...	Ab-i-reshm ...	...	Inert
Centaurea Behhen,	Bahman ...	...	Tonic.
Psoralea corylifolia, Linn.	Bábchi ...	Hooker, II., 103 .	Ditto.
Cinnamomum zeylanicum, Bayn.	Dálchini ...	Brandis, 375 .	Aromatic.
Cinnamomum Tamala, Nees.	Kirkiriya ...	„ 374 ...	Ditto.
Mentha sativa, Linn.	Padína ..	...	Ditto.
Crocus sativus Linn	Zafrán ...	...	Inert.
	Moist remedies.		
Phyllanthus Emblica, Linn	Aonla ...	Brandis, 454 ...	Astringent.
Silica (of the bambu),	Tabáshír ..	„ 566 ...	Inert.
Vitis vinifera (raisins).	Zirishk ..	„ 98 ...	Demulcent.
Camphor ...	Kafúr ..	...	Aromatic.
Onosma echioides, Sm.	Gau-zabán ...	...	Tonic
Coriandrum sativum, Linn.	Dhaniya ...	Hooker, II., 717,	Aromatic.
Nymphæa stellata, Willd.	Nílofar ...	...	Inert.

"From the above list it will be seen that many of the cold remedies are what are used in European therapeutics as astringent medicines, while the hot remedies are principally aromatics, while remedies having various properties fall under the dry and moist categories."

A.

Abrus precatorius, Linn.—A Indian liquorice—*Gunchi, rakti, ratnaliya;* described by Baker in Hooker, Fl. Ind., II., 175. The red or white seeds are used as a weight and as beads in a rosary ; hence the specific name, and also for fistula in native practice .The root is used as a substitute for, and to adulterate, true liquorice, and an extract from it, like that from the latter, is officinal. Pharm., 74, 446.

Abutilon indicum, Don.—*Kangai ;* described by Masters in Hooker, I., 326. The leaves yield a mucilaginous extract used as a demulcent. The root is used in leprosy and in infusion as a cooling drink, and the seeds are considered laxative and are given in coughs.

Acacia arabica, Willd.—*Babul;* described by Baker in Hooker, II., 293. This tree and others of the same genus yield a gum which is used as a substitute for gum-arabic. The bark is considered a powerful astringent and is used as a substitute for oak bark, and the leaves enter into preparations for sores and cutaneous affections Pharm., 62, 77.

Acacia Catechu, Willd.—*Khair;* described by Baker in Hooker, II., 295. The extract called *kath* yields an active principle consisting of mimotannic acid and catechu and is used as an astringent and tonic. Pharm., 62, 63.

Achyranthes aspera, Linn.—*Chirchira;* described by Drury (U. P., 4). The seeds are given in cutaneous diseases, the flowering spikes in hydrophobia, the bruised leaves as an application for stings, and the dried plant in colic. Pharm., 184.

Aconitum ferox, Linn.—Aconite—*Mítha-zahar* (bazaar), *maura-bikh* (root), *mahúr;* described by Hooker and Thomson, I., 28: see also Pharm., 3, 434. This species is found above 10,000 feet and is largely export ed. It yields a deadly poison used in rheumatism and neuralgia.

Aconitum heterophyllum, Linn.—Aconite—*Atís* (root); described by Hooker and Thomson, I., 29. This species also grows at high elevations above 8,000 feet. It is used as a tonic, febrifuge, and aphrodisiac, and with *A. Lycoctonum* (*Bish.*) and *A. Napellus* (*Piliya-kachang* and *dúdhiya*, the roots), occurring at similar elevations, is exported in small quantities to the plains. Pharm., 4, 434.

Acorus calamus, Linn.—*Gur-bach, bach* (root); described by Drury (U. P., 13). The dried rhizomes are used as a bitter, aromatic tonic in fevers, rheumatism, and dyspepsia, and are exported to the extent of about 26 tons every year from the Kumaun forest division. Pharm., 249.

Actiniopteris radiata.—The *Asplenium radiatum* of Royle—*Mor-pankhi, Mor-pachh.* This fern is used as an anthelmintic. The root of *Goniopteris proliferum* is used in fevers and that of *Nephrolepis cordifolia* in electuaries.

Adiantum Capillus-veneris, Linn.—Maiden's hair fern—the *mubáraka* of Kumaun. This fern and *A. venustum* (*Pareseoshán, hansráj*) are exported from the Kumaun forest division, both as a medicine and a dye, to the extent of about 10 maunds a year. They are both considered astringent, aromatic, tonic, and emetic in large doses. The rhizomes and dried leaves of various other species of ferns are sold in the bazaars under the names *iskulikandriyún* and *balíkanbún*, corruptions of the names *Scolopendrium* and *Polypodium*

Ægle Marmelos, Corr.—Bael—*Bel;* described by Hooker, I., 516. The fruit is a specific in atonic diarrhœa and dysentery. Pharm., 46, 441.

Albizzia Lebbek, Benth.—*Siras;* described by Baker in Hooker, II., 298. The bark is applied to sore eyes and the root in making an ointment used in ophthalmia and in cutaneous affections and is given in decoction for diarrhœa.

Allium Cepa, Linn.—Onion—*Piyáj*. This common vegetable is used in special diseases as a stimulant, diuretic, and expectorant. *A. sativum*—Garlic—*Lahsan*—is supposed to have similar properties in native medicine.

Aloe indica, Royle—*Ghikawár;* described by Drury (U.P., 26). The bitter inspissated juice contains a cathartic principle. *A. perfoliata*, Roxb., occurs rarely in gardens in Kumaun. Pharm., 242.

Alstonia scholaris, R. Br.—*Chhatiyún, satiyún* of the Bhábar; described by Drury (U. P., 29). The bark is a powerful tonic, anthelmintic, and antiperiodic: the milky juice is applied to ulcers and mixed with oil in ear-ache. It is also valuable in dysentery and diarrhœa. *A. lucida*, the *dúdhi* of Kumaun, is found on the first range and is said to possess similar properties. Pharm., 137, 455.

Amarantus farinaceus and others of the same and allied genera are held to possess diuretic and purifying properties. Pharm., 184.

Anagallis arvensis, Linn., var. *cærulea*—Pimpernel—*Jonkhmári, jainghani;* described by Drury (F. P., II., 128). Triturated it is used to intoxicate fish and to expel leeches from the nostrils. It is also used in cerebral affections, leprosy, hydrophobia, and dropsy.

Anatherum muricatum, Beauv.—*Kas* or *khas;* described by Drury (U. P., 38). The roots are given in infusion as a febrifuge and in powder in bilious affections and also yield an oil.

Aneilema tuberosa, Ham., *Murdannia scapiflora,* Royle—*Músli-siyáh* and *safed* (roots). The rootlets furnish an astringent, tonic preparation and are exported for this purpose from Kumaun. Pharm., 235.

Anisomeles ovata, R. Br.—*Gobara;* described by Drury (F. P., II., 557). This plant has carminative, astringent, and tonic properties and also yields an oil. Pharm., 168.

Anona squamosa, Linn.—Custard-apple—*Sítaphal, sharífah.* Hooker, Fl. Ind., I., 63. The powdered seeds mixed with flour of gram and water make a hair-wash and the bruised leaves with salt make a cataplasm to induce suppuration.

Artemisia vulgaris, Linn.—*Páti;* described by Roxburgh, 599. This species is common in Kumaun; it has stomachic and tonic properties and is given in fevers. *A. scoparia,* Wall.—*Jhau*—has similar uses. Pharm., 122, 126.

Argemone mexicana, Linn.—*Kantela;* described by Hooker and Thomson, I., 117. An introduced plant now completely naturalized. The seeds yield an oil, used as a mild, cooling laxative. The juice of the plant is diuretic, relieves blisters and heals excoriations and indolent ulcers. Pharm., 22, 440.

Argyreia speciosa, Choisy—*Gao-patta, bich-tárak;* found wild in the Dehra Dún and the Bhábar, described by Drury (U. P., 49). The leaves are used as emollient poultices for wounds and externally in skin diseases, having rubefacient and vesicant properties. *A. setosa* occurs in the Sarju valley near Kapkot. Pharm., 157.

Artocarpus integrifolia, Linn.—Jack-tree—*kathal;* described by Brandis, 425. The juice of the trunk is used in glandular swellings, the young leaves in skin diseases, and the root in decoction in diarrhœa.

Asparagus adscendens, Roxb.—*Khairuwa;* described by Roxburgh, 291. The tuber of this species is used as a demulcent and tonic.

Asparagus racemosus, Willd.—*Sitráwal* (plant), *bozidán* (root), *haliyún* (fruit). The root is used in special diseases and has also demulcent properties in veterinary medicine. Pharm., 243.

B.

Bœnninghausenia albiflora, Reich.—White rue—*Písu-ghás*; described by Hooker, I., 486. Exported and used as a medicine for poultry.

Balanites Roxburghii, Planch.—*Inguwa*; is found in Dehra Dún (Royle), and is described by Bennett, I., 522. The leaves have anthelmintic properties and the bark is used as a cattle medicine. The unripe drupes have strong cathartic properties, but when ripe are pleasant and the seeds are given for coughs.

Baliospermum indicum, Dne.—Croton—*Jangli jamálgota*; described by Drury (F. P., III., 192). The seeds are used as a purgative, but in over-doses are an acro-narcotic poison. They are also used externally as a stimulant and rubefacient. The oil is a powerful hydragogue, cathartic, and useful for external application in rheumatism. Pharm., 201.

Barleria cristata, Linn.—*Gorp-jíba*, *kála-bánsa* (leaves); described by Roxburgh, 471. The seeds are supposed to be an antidote for snake-bites and the roots and leaves are used to reduce swellings and in coughs.

Bassia butyracea, Roxburgh (see page 715 *antea*). The butter is used for rheumatism and as a pomade and lip-salve. The oil of *B. latifolia* is used for soap and emollient ointments and the spirit distilled from the flowers as a stimulant. Pharm., 130, 131.

Bauhinia variegata, Linn.—*Khwairál*, *kachnár*; described by Baker, II., 284. The root in decoction is useful in dyspepsia and flatulency; the flowers with sugar as a gentle laxative; and the bark, flowers or root triturated in rice-water as a cataplasm to promote suppuration.

Benincasa cerifera, Savi—*Bhunja*, *petha*, *kumhra* (see page 700). This gourd has alexipharmic and tonic properties and is given in dysuria in native practice.

Berberis Lycium, Royle—*Kashmal*; described by Hooker and Thomson, I., 110. The root is known as *kingora-ki-jar* in the hills and *dár-hald* and *dár-chob* in the plains. An extract from the roots is known as *rasaut*, and it is chiefly from this species that it is obtained in Sirmor and Garhwál. The medicinal extract is highly esteemed as a febrifuge and as a local application in eye-diseases. It is said by some to have been known to the ancient Greeks and Romans as 'Lykion,' and pots labelled "Best Himálayan Lykion" have been found in the ruins of Pompeii, but this identification is disputed. In Kumaun *B. aristata* and *B. asiatica* yield *rasaut*. The average annual export of the root from the Kumaun forest division is about two maunds and from Garhwál about double the quantity. Pharm., 13, 436.

Boerhaavia diffusa, Linn.—*Gáda-purna;* described by Drury (F. P., III., 34). The root of this common weed is given in infusion as a laxative, anthelmintic, and cooling medicine. Pharm., 185.

Bombax malabaricum, D.C.—*Semal;* described by Masters in Hooker, I., 349. The gum is given in asthenic cases; the root furnishes one of the *musali* and is used as a stimulant and tonic and in large doses as an emetic, and the leaves are employed as an aphrodisiac and in special diseases. Pharm., 36.

Boswellia thurifera, Cole—Indian frankincense—the *salhi* of Garhwál; described by Drury (U. P., 84). The gum is prescribed with clarified butter in special diseases, with cocoa-nut oil for sores, and as a stimulant in pulmonary diseases. Pharm., 52.

Brassica nigra, Koch.—Black mustard—*Káli sarson.* This and the allied species, *B. alba* and *B. juncea,* are frequently used in medicine as rubefacients and vesicants. Pharm., 25.

Briedelia montana, Roxb.—*Kangnaliya;* described by Roxburgh, 705. Reported to possess astringent and anthelmintic properties and found at 3-4,000 feet.

Buchanania latifolia, Roxb.—*Chironji;* described by Brandis, 127. The oil extracted from the kernels of the fruit is used as a substitute for almond oil in native medicinal preparations and confectionery.

Butea frondosa, Roxb.—*Palás, dhák;* described by Brandis, 142. The inspissated juice obtainable by incision is used as a substitute for kino: the seeds as a vermifuge and anthelmintic and when made into a paste as a remedy for ring-worm. *B. parviflora*—*maula*—has similar properties. Pharm., 73, 74, 79, 446.

Buxus sempervirens, Linn.—*Papri, shamáj;* described by Brandis, 447. A tincture from the bark is used as a febrifuge.

C.

Cæsalpinia Bonducella, Fleming—*Karaunj;* described by Baker, II., 254. The kernels are used as a tonic in fevers and made into an ointment with castor-oil and applied externally in hydrocele. An oil is extracted from the leaves which is used in palsy and rheumatism. Pharm., 68, 446.

Callicarpa arborea, Roxb.—*Ghiwála;* described by Drury (U. P., 97). The bark is aromatic and bitter and is applied in decoction in cutaneous affections.

Calosanthes indica, Blume—*Pharkath;* described by Drury (U. P. 100). The bark is astringent and used in applications to cuts and fractures. The seeds are applied to abscesses and the officinal *syonak* seems to be procured from the leaves.

Calotropis procera, R. Br.—*Madár, ák;* described by Brandis, 331. The root, bark, and inspissated juice are used extensively for their emetic, diaphoretic, alterative and purgative properties. Pharm., 141, 457, 458.

Canna indica, Linn.—Indian shot—*Kiwára;* described by Drury (U. P., 106). The root is used as a diaphoretic and diuretic in fevers and dropsy.

Cannabis indica, Linn.—*Bhang*. See intoxicating drugs, *postea*, and Pharm., 216, 463.

Capparis horrida, Linn.—*Ulta-kánta, bipuwa-kánta;* described by Hooker and Thomson, I., 178. Found in the Bhábar. A cataplasm of the leaves is considered useful in boils, swellings, and piles.

Capsicum frutescens, Linn.—*Mircha, kursáni;* prescribed in native practice in gout, dyspepsia, cholera, and ague.

Careya arborea, Roxb.—*Vákamba, kimbhi;* described by Clarke in Hooker, II., 511. The flowers are given as a tonic in sherbet after childbirth.

Carum copticum, Benth.—Lovage—*Ajwáin;* described by Clarke, II., 682. This plant possesses valuable stimulant, carminative and antispasmodic properties ; it aids digestion, and is used in colic, colds, rheumatism and fever and is also esteemed as a diuretic. Pharm., 98, 99, 447. *C. Carui*, Linn.—Carraway—*Kálajíra*—(Hooker, *l. c.*, 680) occurs at the same elevations (8-10,000 feet) and possesses similar virtues. Both are exported to the plains.

Cassia Absus, Linn.—*Banár;* described by Baker, II., 265. The seeds are used in powder applied beneath the eyelids or in the form of an ointment in ophthalmia. Pharm., 78.

Cassia Fistula, Linn.—*Kitola, itola, ráj-briksh* of the Bhábar ; described by Baker, II., 256. This tree yields the commonest cathartic used in native medicine. The pulp around the seeds is a valuable laxative, the flowers are used as a febrifuge made into a confection known as *gúl-kand*, and the root is a strong purgative. The bark and leaves are applied to cutaneous eruptions. Pharm., 65.

Cassia Sophera, Linn.—*Banár* of the Bhábar ; described by Baker, II., 262. The bark, leaves, and seeds of this tall weed are cathartic and the juice of the young leaves is applied in ringworm. *C. Tora* has the same native name in Kumaun ; its leaves are eaten by men and animals and the seeds are used as a remedy for itch. Pharm., 78.

Cedrela Toona, Roxb.—*Túni;* described by Drury (U. P., 128). The bark is astringent and has been found a fair substitute for quinine in fevers and bowel complaints, especially with young children. Pharm., 55.

Celosia argentea, Linn.—*Siráli, sarwáli, gogiya ;* described by Drury (F. P., III., 15). The seeds are used chiefly in special diseases.

Chavica Roxburghii, Miq.—*Piper longum,* Linn.—fruit *pípla-múl* ; described by Drury (U. P., 131). *P. longum,* var. *silvaticum,* grows wild and the fruit is largely exported as a condiment and a stimulant in medicine. Pharm., 208.

Chenopodium album, Linn.—*Bhatuwa ;* described by Drury (F. P., III., 5). It is used in special diseases and as a laxative in spleen and bilious disorders.

Cicer arietinum, Linn.—Gram—*Chana* (see page 693). The hairs of the stem and leaves exude an acid used as a refrigerant in fevers; the seeds are considered stimulant and when roasted are used as a substitute for coffee berries. Pharm., 80.

Cinnamomum Tamala, Nees—*Tej* (bark), *tejpát* (leaves); described by Brandis, 374. The bark and leaves are used as a carminative, aromatic and stimulant in coughs and dyspepsia and generally as a substitute for true cinnamon. Pharm., 196.

Cissampelos Pareira, Linn.—*Pari;* described by Hooker and Thomson, I.,203. The dried root has diuretic, tonic and slightly aperient qualities and forms part of the *píli-jari* or 'yellow-root' of the native Materia Medica. The leaves are applied to abscesses. Pharm., 7.

Citrullus Colocynthis, Schrad.—*Indráyan* (see page 701). The fruit affords a safe and active cathartic in hepatic and visceral congestion. *C. Hardwickii*, the *air-alu* of Kumaun and *pahárìindráyan* of the plains, has similar properties. Pharm., 94.

Citrus Aurantium, Linn.—Orange—*Nárangi*—(2) *C. medica*—*Bijaura*—(3) *C.* var. *Limonum*—*Jámíra*—and (4) *C.* var. *Limetta*—*Amritphal*—are all used in medicine as tonics and purifiers of the blood, refrigerants in fevers, flavouring materials in infusions, pomades, &c., anti-scorbutics, stomachics, and carminatives. The juice is exported from the Kumaun forest-division to a great extent every year. Pharm., 42, 43, 45.

Cleome viscosa, Linn.—*Jangli-karhar;* described by Hooker and Thomson, I., 170. The seeds are considered anthelmintic; the leaves are used as a vesicant, and boiled in clarified butter are applied to wounds, and the juice to ulcers. The root is administered in decoction as a febrifuge. This plant is often confounded with *Gynandropsis pentaphylla.*

Clerodendron serratum, Spr.—*Ganth-baharangi;* described by Drury (U. P., 141). The leaves of this common plant are boiled in oil for applications in ophthalmia: the roots boiled in water with ginger and coriander are given in nausea, and the seeds are slightly aperient. The leaves of *C. infortunatum*, Linn.—*Bhat*—also afford a cheap and efficient tonic and antiperiodic. Pharm.,

164. *C. Siphonanthus*, R. Br.—*Arni*—also occurs and its roots and leaves are officinal in native practice.

Cochlospermum Gossypium, D. C.—*Katera, gajra;* described by Hooker and Thomson, I., 190. This small tree yields a gum used as a demulcent in coughs and special diseases. Pharm., 27.

Colocasia antiquorum, Schott.—*Kachu, arwi;* described by Drury (U. P., 155). The inspissated juice of the petioles is a capital styptic for wounds. Pharm., 250.

Commelyna obliqua, Don.—*Kanjura, kána*. The root is useful in vertigo, fevers, and bilious affections, and is said to be used as an antidote to snake-bites.

Corchorus olitorius, *Linn.—Banphal; found in* Dehra *Dún;* described by Masters in Hooker, Fl. Ind., I., 397. The leaves are emollient and used in infusion as a refrigerant in fevers and special diseases. The dried plant toasted and powdered is used in visceral obstructions.

Cordia latifolia, Roxb.—*Bairálu, baurála;* described by Drury (U. P., 160). The fruit is used as an expectorant and astringent. Pharm., 157.

Cordia Myxa, Linn.—*Koda;* described by Drury (U. P., 161). The pulp of the fruit is used as a laxative and the seeds mixed with oil are deemed a specific in ringworm. The juice of the bark in infusion is given with cocoa-nut oil in gripes. Pharm., 157.

Coriandrum sativum, Linn.—Coriander—*Dhaniya;* described by Clarke, II., 717. The dried ripe fruit and the volatile oil are both used in medicine as an aromatic stimulant in colic and the like. Pharm., 101.

Costus speciosus, S. M.—*Keyu, keoli, kút-shirín* (root); described by Drury (U. P., 164). From the root a strengthening tonic is made and it is also used as an anthelmintic.

Crinum asiaticum, var. *toxicarium*, Herb.—*Chindar, kanwal, pindar, kanmu;* described by Roxburgh, 283. A valuable emetic; in small doses nauseant and diaphoretic. The dried sliced roots are also emetic: the leaves with castor-oil are used in rheumatism and the juice in ear-ache. Pharm., 234.

Cucurbita Pepo, Linn.—*Bhánga, petha;* and *C. maxima—gaduwa* (see page 702). Both these gourds are used in medicine; the leaves as applications for burns and the seeds as anthelmintics. Pharm., 96.

Cuminum Cyminum, Linn.—*Jíra* (see page 705.) Both fruit and oil possess carminative properties allied to dill and coriander: the seeds are largely exported to the plains. Pharm., 108.

Curculigoorchioides, Gœrtn.—*Petári;* described by Drury (F. P., III., 458). The tuberous roots are some of those known as *músli-siyáh* and are held in the highest esteem by native physicians as a specific in special diseases. Pharm., 235.

Curcuma longa, Roxb.—Turmeric—*Haldi* (see page 706.) This is much used as an application in bruises: the fresh juice as an anthelmintic; the fumes of the burning root in coryza and the root in decoction for relieving catarrh and purulent ophthalmia. Pharm., 231.

Cymbopogon Martini, Munro—*Bujina, pála-khari.* The oil, known as *raus-ka-tel* and Nimar oil, enters largely into native perfumery. The roots of *C. laniger—Piriya*—are also used as an aromatic stimulant (see Drury, F. P., III., 641). Pharm., 256.

Cynodon Dactylon, Pers.—*Dúb;* described by Drury (U. P., 180). This grass yields a cooling decoction from the roots and young leaves found useful in fever.

Cyperus rotundus, Linn.—*Motha;* described by Drury (U. P., 182). The roots are held to be diaphoretic, diuretic, and astringent Pharm., 250.

D.

Dalbergia Sissoo, Roxb.—*Sisu;* described by Drury (U. P., 186). The leaves and saw-dust in decoction are esteemed in eruptive and special diseases and to allay vomiting. The oil is also applied externally in cutaneous affections.

Datisca cannabina, Linn.—*Bujr-bhanga, bhang-jala* (roots); described by Clarke, II., 656. The roots are exported as a medicine useful as a sedative in rheumatism and to aid in dyeing red.

Datura alba, Linn.—*Dhatúra;* described by Drury (U. P., 188). The leaves and seeds are used as anodynes and antispasmodics. Pharm., 175, 460.

Daucus Carota, Linn.—Carrot—*Gájar.* This common vegetable is used as a poultice for ulcers and boils.

Delphinium Brunonianum, Royle—*Nepárí;* described by Hooker and Thomson, I., 27. Occurs at 14,000 feet and is exported for its highly musk-scented leaves, used in native perfumery and for temple offerings.

Dendrocalamus strictus, Nees—Bambu—*Báns, básila;* described by Brandis, 529. The bambu yields a siliceous secretion in the joints of the female plant, called *báns-lochan* or *tabashír,* considered by the Baids to be useful as a stimulant and aphrodisiac. The root is said to be a diluent, the leaves are used as an emenagogue and anthelmintic and the dried stems as splinters in surgery, which seems to be the only really valuable use that the products of the bambu are put to in medicine. The product *banslochan* is exported in small quantities from Kumaun. Pharm., 256.

Desmodium triflorum, D. C.—*Kudaliya;* described by Drury (U. P., 190). The fresh leaves are applied to wounds and abscesses that do not heal well.

Dioscorea versicolor, Wall.—Yam—*Genthi, gajir.* The tubers yield a farinaceous food for invalids.

Diospyros Melanoxylon, Roxb.—*Tendu;* described by Brandis, 291. This and the other species of ebony afford an astringent from the bark which is used in decoction in diarrhœa, dyspepsia, and the like as a tonic. Pharm., 132.

Dolichos sinensis, Linn.—*Lobiya* (see page 695). This and other similar pulses are prescribed in special diseases and as stomachics.

Drosera peltata, Gm.—*Mukha-jali;* described by Clarke, II., 424. The leaves bruised and mixed with salt are used as a blister in Kumaun.

E.

Eclipta erecta, Linn.—*Moch-kand, bhongra, bábri;* described by Drury (U. P., 202). The fresh plant is applied with sesamum oil in elephantiasis; the expressed juice in affections of the liver, spleen, and dropsy, and in large doses as an emetic; also as a black hair-dye. The average annual export from the Kumaun forest division is about 5 maunds. Pharm., 128.

Elæagnus umbellata, Thunb.—*Ghiwáin, kankol;* common in the hills from the Jumna to the Sárda; described by Brandis, 390. The seeds are reported to be used as a stimulant in coughs, the expressed oil in pulmonary affections, and the flowers as a cardiac and astringent.

Elæodendron glaucum, Pers.—*Shauriya* (Kumaun) and *jamuwa* (Dehra Dún); described by Roxburgh, 214. The root is held to be an antidote in snake-bites; a decoction or cold infusion of the fresh bark of the roots is applied to swellings.

Embelia robusta, Roxb.—*Bayabirang* (fruit); described by Brandis, 284. The fruit is said to be used to adulterate black pepper like that of *E. Ribes,* which has the same vernacular name and is given as an anthelmintic and internally for piles. The greater portion of the *bayabirang* exported from Kumaun seems to be the fruit of *Myrsine africana.*

Eragrostis cynosuroides, Rot.—*Dábh.* A common grass said to possess diuretic and stimulant virtues.

Eugenia Jambolana, Lam.—*Phaunda;* described by Brandis, 233. The leaves and bark are astringent.

Euphorbia pentagona, Bois.—*Sehund.* This and other species of the same genus yield an acrid milky juice having cathartic and anthelmintic properties. Pharm., 204.

Exacum tetragonum, Roxb.—*Tilakhana;* described by Roxburgh, 133. It is used as a tonic in fevers and a stomachic bitter. Pharm., 149.

F.

Feronia Elephantum, Corr.—*Kath-bel;* found in the Siwáliks and Bhábar; described by Drury (U. P., 220). This tree yields a gum used for the same purposes as gum-arabic; and the leaves are carminative and stomachic, especially with children. Pharm., 48.

Ficus Carica, Linn.—Fig—*Anjír;* described by Brandis, 418. The fruit is used medicinally as a laxative.

Ficus indica, Roxb. (*F. bengalensis,* Linn.)—*Bar, bat* ; described by Drury (U. P., 221). The juice collected from incisions in the bark of the banyan-tree is considered a specific in cracked heels, excoriations, and sometimes for tooth-ache, lumbago, and croup. Pharm., 217.

Ficus religiosa, Linn.—*Pipal* ; described by Drury (U. P., 225). The young shoots are used as a purgative and have some reputation in skin diseases ; the bark of this and the preceding is used as a tonic in decoction. The seeds are given in electuary as a purifier of the blood.

Ficus hispida, Linn., *f.*—*Kágoha, gobla, dhúra, totmíla;* described by Brandis, 423. The fruit, seeds, and bark are possessed of emetic properties. Pharm., 217.

Ficus glomerata, Roxb.—*Gúlar ;* described by Brandis, 422. The bark is used as an astringent and a wash for wounds. The milky juice is given in piles and diarrhœa and in combination with sesamum oil in cancer. The root is useful in dysentery.

Flacourtia sepiaria, Roxb.—*Kandai;* described by Brandis, 18. This tree yields an antidote to snake-bites from an infusion of the leaves and roots : the bark triturated in sesamum oil is used as a liniment in rheumatism.

Fœniculum vulgare, Linn. Fennel—*Sonf;* described by Clarke in Hooker, II., 695. It is used as a carminative and stomachic, cultivated. Pharm., 100.

Fraxinus floribunda, Wall.—*Angu ;* described by Brandis, 302. A concrete saccharine exudation (manna) from the stem is obtained by incision and is a substitute for the officinal manna. Pharm., 136.

Fumaria parviflora, Lam ; Var. *Vaillantii,* the *Khairuwa* of Kumaun, also known as *pitpápra, mijálu* ; described by Hooker, *f.*, and Anderson in Hooker, I., 128. The dried herb is employed as a diuretic, anthelmintic, diaphoretic, and aperient, especially as a blood purifier. The average annual export from the Kumaun forest division is about 32 maunds.

G

Gentiana Kurroo, Royle.—*Karu, kútki*—Himálayan gentian. This plant occurs near the snows. There are four or five allied species, all of which are exported to the plains to the extent of about five tons a year, and are there sold as a valuable bitter tonic. See Royle, Ill. Bot., Him. Moun., pl. 58, fig. 2, and Pharm., 149.

Geranium ocellatum, Camb.—*Bhánd;* described by Edgeworth and Hooker, *f.*, in Hooker, I., 433. A very common plant in Kumaun, which possesses diuretic and astringent properties.

Gloriosa superba, Linn.—*Bish nangál, bish ningála;* described by Drury (U. P., 234). The root is used in special diseases, but is said to be poisonous in large doses. Pharm., 242.

Gmelina arborea, Roxb.—*Kumbhár, gumbhár;* described by Drury (U. P., 234). The root is given in coughs, rheumatism, and special diseases, and is said to have anthelmintic properties like *A. asiatica.* Pharm., 164.

Gossypium herbaceum, Linn.—Cotton—*Kapás.* The down of this well-known shrub is applied to burns; the seeds to increase milk, also in epilepsy and as an antidote to snake-poison; the root as a diuretic, emenagogue, and demulcent, and the leaves in decoction as a tonic in fever and diarrhœa. Pharm., 33.

Grewia asiatica, Linn.—*Pharsiya;* described by Masters in Hooker, I., 386. The leaves are used as an application to pustular eruptions and the fruit in sherbet as a refrigerant in fevers and a gargle for sore-throat.

Gynandropsis pentaphylla, D. C.—*Kathal parhar;* described by Hooker, *f.*, and Thomson in Hooker, I., 171. It occurs common in the Bhábar; the leaves are used as a rubefacient and vesicant; the expressed juice is given with salt in earache; the seeds in powder are given with sugar internally in fevers and bilious complaints, and the entire plant with sesamum oil is used as an ointment in cutaneous affections. Pharm. 25. This plant is often confounded with *Cleome viscosa* in native shops.

H.

Hedychium spicatum, Smith—*Kachúr-kachu, kapúr-kachri, banhaldi.* It possesses carminative and stimulant properties and is especially used as a cattle medicine: it is exported from Kumaun to the extent of a few tons annually. Pharm., 232.

Helicteres Isora Linn.—*Jhonkha-phal, maror-phal;* described by Masters in Hooker, I., 365. The seeds according to 'the doctrine of signatures' are considered useful in colic and diarrhœa and as a blood purifier: and are exported from the Kumaun forest division to the extent of about a ton per annum.

Heliotropium brevifolium, Wall.—*Safed-bhangra, chiti phúl.* The whole plant is laxative and diuretic; the juice is used as an application to sore-eyes, gum-boils and sores generally to promote suppuration and as a cure for the sting of nettles and insects.

Herpestis Monniera, H. B. *et* K.—*Jal-ním;* described by Drury (U. P., 249). A dose of six *máshas* of the leaves steeped in water is an esteemed aperient; the water may be used as an embrocation in skin diseases and croup, and the juice with kerosine-oil is used in rheumatism Pharm., 161.

Hiptage Madablota, *Gœrtn.*—*Aita-lugala; described by* Hooker, I., 418. The leaves are esteemed useful in cutaneous diseases.

Holarrhena antidysenterica, R. *Br.*—*Kuár and moriya* of Bijnor and *kúer, kúda, kura* of Kumaun; described by Brandis, 326. The bark is a specific in dysentery: hence the name, and the seeds are also said to possess similar properties. Pharm., 137, 455.

Hordeum hexastichon, Linn.—Barley—*Jau.* The husked seeds form pearl barley, a favourite food for invalids and in decoction a drink in fevers. Pharm., 253.

Hymenodictyon excelsum, Wall.—*Bhúlan, bhalena, bhamena, dhaulí;* common in the Kota Dún; described by Brandis, 267. The inner coat of the bark possesses the bitterness of cinchona and its astringent properties. Pharm, 117.

Hyoscyamus niger, Linn.—Henbane—*Khorasáni ajwáin* (seeds); occurs wild and is also cultivated. The seeds are given in native medicine as an anodyne and sedative in mental diseases. Pharm., 178.

I.

Ichnocarpus frutescens, R. Br.—*Dúdhi;* described by Drury (U. P., 259). The root possesses alterative, tonic properties and is employed as a substitute for sarsaparilla: the stalks and leaves are used as a decoction in fevers. Pharm., 138.

J.

Jasminum grandiflorum, Linn.—*Jáhi;* very abundant in low valleys; described by Brandis, 313. The flowers and their essence are used as an application in skin diseases, headache and weak eyes: the leaves are used in toothache. Other species of this genus are also found in Kumaun and are employed in making perfumed waters.

Jatropha Curcas, Linn.—*Safed ind;* described by Drury (U. P., 276). The oil from the seeds is used as a purgative, but is uncertain: it is also applied diluted in rheumatism: the leaves warmed with castor-oil form a poultice for bruises: the seeds in over-doses are poisonous, and the milky juice is used to destroy maggots in sores on sheep. Pharm., 203.

Juglans regia, Linn.—Walnut—*Akor, akhrot, kharot.* The bark is used as an anthelmintic: the leaves are astringent and tonic and in decoction a specific in strumous sores: the fruit is given in special diseases and rheumatism.

Justicia Adhatoda, Linn.—*Bashing;* described by Drury as *Adhatoda vasica* (U. P., 16). The flowers, leaves, and roots are considered antispasmodic and anthelmintic; the juice is found useful in pulmonary affections, and a tincture is also commonly given as an expectorant. Pharm., 162.

K.

Kydia calycina, R. W.—*Puta;* described by Masters in Hooker, I., 348. The bark is mucilaginous and is used to clarify sugar.

L.

Lepidium sativum, Linn.—Cress—*Halang.* The seeds of this common vegetable are used as a tonic laxative and antiscorbutic and as a gentle stimulant in indigestion.

Lilium wallichianum, Royle—*Findora.* The dried bulb scales possess demulcent properties and are used like salep in pectoral complaints.

Limonia acidissima, Linn.—*Bali;* described by Hooker, I., 507. The root is purgative, sudorific, and used in colic: the leaves in epilepsy and the dried fruit as a tonic and disinfectant. Pharm., 43.

Linum usitatissimum, Linn.—Flax. The seeds are the linseed of the pharmacopœia, of which the uses are well known. Pharm., 37.

M.

Mallotus phillipinensis, Müll.—*Roini, roli;* described by Drury as *Rottlera tinctoria* (U. P., 378). The powder on the seeds is a valuable anthelmintic, vermifuge, and purgative. Pharm., 202.

Malva rotundifolia, Linn.—*Sonchala;* described by Masters in Hooker, I., 320. The seeds are demulcent and are used especially in bronchitis, inflammation of the bladder, and hæmorrhoids, and externally in cutaneous affections and coughs.

Malva sylvestris, Linn.—*kanji, tilchuni;* described by Masters in Hooker, I., 320. It is a valuable demulcent in pulmonary affections and a substitute for the marsh mallow of Europe.

Mangifera indica, Linn.—Mango—*Amb.* The sliced rind of this well-known fruit is astringent and used as a stimulant tonic in debility of the stomach : the kernels are styptic in hæmorrhoids, astringent in diarrhœa, and tonic in fever. Pharm., 59.

Melia Azedarach, Linn.—*Bakáyan, dek, jek, betain;* described by Brandis, 68. The bark of the root and the pulp of the seeds are anthelmintic in small doses and poisonous in large doses. Pharm., 55.

Melia indica, Linn—*Ním;* described by Brandis, 67. The bark, leaves, and seeds are all really valuable; the bark as a febrifuge and substitute for quinine; the leaves as a cataplasm for wounds and sores; and the seeds for their oil, which is used as an anthelmintic and an application to foul sores. Pharm., 55.

Mentha viridis, Linn.—Spearmint—*Pahári pudína.* The oil obtained by distillation from the fresh herb in flower is inferior only to peppermint and is useful in cholic, nausea, and flatulence. Pharm., 166.

Mimosa rubicaulis, Lam.—*Agla;* described by Baker in Hooker, II., 291; *M. pudica,* Linn.—*Lajawanti;* described by Hooker (*l.c.*) The seeds of both are used as purifiers of the blood, and the leaves are given in infusion in piles, and pounded they are applied to burns.

Mirabillis Jalapa Linn.—*Gúl-bánsa.* The root forms a safe and efficient purgative equal to jalap, and the leaves are applied to abscesses. Completely naturalised in Kumaun. Pharm., 184.

Momordica charantia, Willd.—*Karela;* described by Drury, U. P., 306 (see page 700). Used as a laxative and in preparation as an ointment for sores and the juice of the leaves as an anthelmintic.

Moringa pterygosperma, Gœrtn.—*Sahajna*—Horse-radish tree; described by Hooker, II., 45. The fresh roots are vesicant and rubefacient and useful in rheumatism. Used internally, the fresh juice of the roots has stimulant and diuretic properties and the root in decoction furnishes a gargle. The seeds yield a fine oil useful in rheumatism, and the tree itself a gum used as an anodyne in headache and as an application to buboes. Pharm., 61.

Morus indica, Linn.—Indian mulberry—*Tútri;* described by Brandis, 408. The fruit forms a sherbet used as a refrigerant and the bark a vermifuge and purgative. The fruit of *M. serrata,* Roxb.—*Kemu*—and *M. lævigata,* Wall., *Siyah-tút*—is said to possess similar properties. Brandis, 409.

Mucuna pruriens, D. C.—Cowhage—*Goncha;* described by Baker in Hooker, II., 187. The hairs of the legume are mechanically anthelmintic and are given in round worm: see Pharm., 73. The seeds are given with milk in special diseases and snake-bites and the leaves as a vermifuge. *M. atropurpurea,* the *baldhaki* of Kumaun, is said to possess similar properties.

Murraya Kœnigii, Spreng.—*Gani, gándla;* described by Hooker, I., 503. The seeds yield a clear transparent oil known as simboli oil; the root is laxative and both bark and roots are stimulant and used in cutaneous diseases and to check vomiting. Pharm., 49.

Musa Sapientum, Linn.—Plantain—*Kela.* This well-known fruit is demulcent, antiscorbutic, and alterative; the tender leaves are used as a dressing for wounds, blisters, and sores, and as eye-shades in ophthalmia; the root and stem are considered in native practice purifiers of the blood and are good in scorbutic complaints and special diseases. Pharm., 233.

Myrica sapida—*Káiphal;* described by Brandis, 493. The fruit is eaten, and the bark is used externally as an anthelmintic, stimulant, and rubefacient, and in the arts as a tanning agent. Natives use it in epilepsy and to rub the body after illness. The average annual export of this bark from the Kumaun forest division is about fifty tons. Pharm., 217.

Myrsine africana, Linn., the so-called box—*Pahári-cha, chúpra;* described by Brandis, 286. The fruit is said to be a powerful cathartic vermifuge. It is sold in the bazaars as *bayabirang*, a name also of *Embelia Ribes;* used also in dropsy, colic, and as a laxative. About a maund is exported every year from the Kumaun forest division. *M. semiserrata*, Wall., also called *chúpra*, is said to possess similar properties.

N.

Nardostachys Jatamansi, D. C.—Spikenard—*Bálchhar, shambal, balkar.* Royle, *t.* 54, *f.* 2. This plant occurs above 12,000 feet and its roots with those of certain species of Valerian, especially *V. Hardwickii* (*shameo*, roots), are exported through the Kumaun forest division to the extent of about twenty maunds per annum. They occur in the form of short pieces of an underground stem, about the thickness of a quill, covered towards one extremity or almost entirely with coarse, dark, hair-like fibres. It has all the properties of Valerian in a high degree and is used as a stimulant and antispasmodic in hysteria and epilepsy. *N. grandiflora*, a larger species, also occurs in Kumaun at similar elevations. Pharm., 120. : Bird., 46.

Nelumbium speciosum, Willd.—Lotus—*Kanwal;* described by Hooker *f.* and Thomson in Hooker, I., 116. The nuts are eaten as a tonic in disorders of the digestive functions.

Nerium odorum, Aiton.—Oleander—*Kaniyár;* described by Drury (U. P., 323). All parts of the plant are poisonous and are used in native practice in leprosy, cutaneous affections, and as an anthelmintic. The bark in paste is used in ringworm and itch and a decoction of the leaves externally as a vermifuge. Pharm., 139.

Nicotiana Tabacum, Linn.—Tobacco—*Tamáku, dhamáku.* For the medicinal uses of tobacco see Pharm., 178, 460, and O'Shaughn., 471.

Nyctanthes Arbor-tristis, Linn.—*Kúri, harsinghar;* described by Drury (U.P., 323). Used in native practice for ringworm and to promote the adhesion of broken bones, also in indigestion: the bark is an astringent and is used as a gargle and in applications to sores and ulcers.

O.

Odina Wodier, Roxb.—*Jingan, jíban;* described by Hooker, II., 29. The bark is used in decoction as a lotion in impetigo and obstinate ulcers: the gum and leaves have also astringent properties and are applied to bruises and wounds. Pharm., 60.

Olea glandulifera, Wall.—*Gair, galdú, garur;* described by Brandis, 309. The bark and leaves are astringent and are used as an antiperiodic in fevers.

Onosma echioides, Linn.—*Maharanga, lál-jari,* and *ratan-jot* (root), *gauzabán* (leaves), *gul-i-gau-zabán* (flowers). The bruised root is applied to eruptions, the leaves as an alterative, and the flowers in cases of rheumatism and palpitation of the heart as a cardiac and stimulant. Exported through Dehra Dún. The root is also used as a dye. It appears that under the name '*ratanjot*' the roots of *Geranium nodosum*, Linn.; of *Potentilla nepalensis*, Hook.; *Macrotomia euchroma*, H. *f. et.* T.; and *Jatropha Curcas*, are also collected and sold.

Ophelia Chirayta, Gris.; *Agathotes chirayta*, Don.—*Títa-khána, chirayta.* Some call this species the true *Dákhini* chiretta or true Nepál chiretta. The former name is properly applied to a South-Indian species, *Andrographis paniculata,* and the latter name may perhaps suit, as *O. Chirata* occurs in Nepál. Equally good chiretta is obtained from *O. purpurascens, O. cordata, O. speciosa, Agathotes angustifolia* and *A. alata.* All yield a valuable bitter extract used as a tonic and febrifuge and corrector of biliary disturbance. About six tons are exported every year from the Kumaun forest division. See further Pharm., 149: As. Res., XI., 167.

Oxalis corniculata, Linn.—*Chalmori;* described by Edgeworth and Hooker *f.* in Hooker, I., 436. The leaves, stalks, and flowers possess refrigerant and antiscorbutic properties and are used internally in fevers, dysentery, and scurvy, and externally to remove warts. The juice is useful in removing iron-moulds.

P.

Pœonia emodi, Wall.—*Chandra* (the plant), *sujúniya* (the young edible shoots), *bhúma-madiya, yet ghás* of the Bhotiyas ; described by Hooker *f.* and Thomson in Hooker, I., 30. The tubers are some of those exported under the name *bikh* and are probably those known as *padam-chhál.* There is nothing in the local Materia Medica requiring further investigation more than the roots exported under the name '*bikh*' and '*nirbisi.*' Under the former come the various species of aconite. *A. ferox* is the *maura, máúr* or *máhur bikh*, and Madden tested it to see whether it deserved the name '*mítha*,' sweet, and found it was so : but this was soon succeeded by the most distressing burning all over the mouth and fauces, though nothing was swallowed. Dr. Royle says that *Polygonatum verticillatum*, Linn., is called *mítha-dúdhiya* in Sirmor and *Smilacina pallida* is called *dúdhiya-mohura*, and both are poisonous. The cylindrical tuberous roots of *Delphinium kashmerianum*, Royle, found at Pindari in Kumaun and Bhojgara on the south side of the Kawári pass in Garhwál (11,000-14,000 feet), are absolutely identical with the ordinary *nirbisi* roots. See Madden, An. Mag., N. H., 2nd Ser., XVIII., 445.

Parmelia kamtschadalis, Esch.—Lichen—*Chalchalíra, patharke-phúl.* Several species are exported to the plains and are used in native practice as a tonic febrifuge and antiperiodic. See Pharm., 260.

Peucedanum graveolens, Benth.—Dill—*Soya ;* described by Clarke in Hooker, II., 709. An excellent carminative for relieving flatulence in children. Pharm., 101.

Pharbitis Nil, Choisy—*Baunra ;* described by Drury (U. P., 350). A safe and effectual cathartic. Pharm., 155.

Phyllanthus Emblica, Linn —*Amla, aonla ;* described by Brandis, 454. The dried fruit is astringent and when fresh is given as a tonic aperient : the flowers are refrigerant and aperient and the bark is astringent. See Pharm., 204, and O'Shaugh., 551. The leaves of *Paraphyllanthus urinaria* (*seráhi*) and of *Phyllanthus niruri*, Linn., are given in infusion as a diuretic and the fresh roots of both in jaundice. See Drury.

Picrorhiza Kurrua, Roxb.—*Kuruwa*. Found only at high elevations about 11,000-14,000 feet : the bitter roots are exported with *Saxifraga ligulata* under the name *pákhán-bed*, and with *Gentiana Kurroo* under the name *kútki*, to the extent of about three tons a year and are used as a tonic. *Nima quassioides* occurs in upper Garhwál (5,500-8000 feet) and is known as *karwi* and has similar uses.

Pinus longifolia, Roxb.—Pine—*Chír*. This pine is very common in Kumaun and yields a turpentine and resin : for uses see Pharm., 222, 219. The turpentine from *P. Gerardiana* is used principally in special diseases, and that from *P. Deodára* in cutaneous diseases and as a diuretic. Pharm., 225.

Pistacia integerrima, J. L. S.—*Kakra, kakra-singi* ; described by Hooker, II., 13. The gall-like excrescences formed on the leaves and petioles in October are exported as a medicine and are esteemed useful in coughs, asthma, fever and dysentery, and as a sedative. They occur black, hard, rugose, hollow, irregularly crooked, often 6′-7′ long. The average annual export from the Kumaun forest division is about seventy maunds. Brandis, 122, 574.

Pithecolobium bigeminum, Mart.—*Kachlora* ; described by Brandis, 178. A decoction of the leaves is used in leprosy and as a stimulant to promote the growth of hair.

Plantago major, Linn.—*Luhuriya*. It is doubtful whether this has the properties of *P. decumbens*, Forsk., the *isbaghol* of the bazars. Pharm., 182.

Plumbago zeylanica, Linn.—*Chita, chitra* ; described by Roxburgh, 155. The roots triturated in water form a vesicant and in tincture a good antiperiodic : they are exported from the Kumaun forest division to the extent of about twelve maunds annually. Pharm., 170 : O'Shaugh., 508.

Pongamia glabra, Vent.—*Pápar, Sukh-chain* ; described by Baker in Hooker, II., 240. The seeds yield an oil much used in skin diseases and as an embrocation in rheumatism : the leaves are also officinal. Pharm., 79, and J. Agri.-H., Cal., X., 223.

Pontedera vaginalis, Linn.—*Nauka;* described by Drury (U.P., 364). The root is chewed for toothache and the bark is eaten with sugar for asthma.

Populus ciliata, Wall.—*Chalniya, chauniya, chan, gar-pípal;* described by Brandis, 475. It is occasionally used as a tonic stimulant and purifier of the blood.

Portulaca oleracea, Linn.—Small purslain—*Lúniya-kúlfah;* described by Drury (U.P., 364). The bruised leaves are used as an anodyne and are given as a refrigerant and antiscorbutic in cutaneous diseases. Bird., 38.

Premna integrifolia, Linn.—*Bakarcha* of Garhwál; described by Drury (U.P., 365.) The root is given in decoction as a cordial and tonic; the leaves beaten up with pepper are also administered in colds and fevers. The whole plant is given in decoction in rheumatism and neuralgia. The milk of the bark of *P. mucronata*, the *agnián* of Kumaun, is applied to boils and the juice is given to cattle in colic.

Primula speciosa, Linn.—*Bish-kopra, jal-kútra.* It is found along streams from 3,500-5,500 feet in Kumaun: it is said to be poisonous to cattle and is used externally as an anodyne.

Prinsepia utilis, Royle.—*Chírara, jhatela, dhatela, phaláwa, bhekla;* described by Hooker, II., 323. This shrub yields an oil used as a rubefacient and as an application in rheumatism and pains from over-fatigue: a small quantity is exported from the forests and pays a duty of five rupees per maund.

Prunus Communis, var. **domestica**, Linn.—Prune. See page 712. The dried drupe is considered a laxative and emollient and is used in medicinal confections. Pharm., 86. The *alu-bukhára* is used as a refrigerant and laxative both in a cold infusion and a confection. *P. persica*—the peach—is given as a demulcent and antiscorbutic and stomachic. The oil from the kernels is considered a valuable vermifuge and strengthener of the hair. The kernel of *P. Puddum* is used in stone and gravel, and that of *P. Padus* yields a poisonous oil, like oil of almonds, much used in medicinal preparations.

Psidium Guyava, Linn.—Guava—*Amrúd;* described by Baker in Hooker, II., 148. The bark of the root is given in decoction in infantile diarrhœa and the young leaves as a tonic in diseases of the digestive functions. Pharm., 92.

Pueraria tuberosa, D.C.; *Hedysarum tuberosum*, Roxb.—*Biláí-kand*, *bili*, *birálí-panwa* (Kumaun), *sural* (Jaunsár), *sarár*, *sarwála* (Bijnor); described by Baker in Hooker, II., 197. The tubers are dug up and exported in large quantities to the plains, where they are considered demulcent and refrigerant in fevers and useful as a cataplasm for swollen joints.

Punica Granatum, Linn.—Pomegranate—*Anár* (cultivated); *dárim* (wild); *naspál*, *kushiála* (rind of fruit). The root-bark and dried rind possess powerful astringent properties from the presence of tannin. The former is considered anthelmintic in European practice and the latter astringent. See Pharm., 93, 447.

Putranjiva Roxburghii, Wall.—*Júti*, *putrajiva;* described by Drury (U. P., 372). Given in decoction in colds and fevers.

Pyrus Cydonia, Linn.—Quince—*Bihi*. See page 713, *Cydonia vulgaris*. The seeds are used as a demulcent in native practice and as a tonic; also in decoction in dysentery and special diseases: Pharm., 86.

Q.

Quercus incana, Roxb.—*Bánj;* described by Brandis, 482. The acorn (*sil-supári*) washed and powdered is used as an astringent in indigestion, diarrhœa, and asthma. Pharm., 209.

R.

Randia dumetorum, Law.—*Mainphal*, *manyál*, *karhar;* described by Drury (U. P., 373). The fruit is highly esteemed as an emetic and is used to poison fish and the bark of the root in infusion to nauseate. Pharm., 118.

Raphanus sativus, Linn.—Radish—*Múli*. The seeds of this common vegetable have diuretic and laxative properties and the roots are prescribed in native practice for special and urinary diseases.

Rheum emodi, Wall.—*Dolu*. This species is found near the Pindari glacier and at similar elevations in Kumaun and Garhwál; the average annual export from the Kumaun forest division is about 1,000lb. This and *R. Webbianum*, Royle, are used as a substitute for Turkey rhubarb. *R. emodi* is less active as a purgative and more spongy in texture. See Pharm., 187 : O'Shaugh., 519 : Panjab Products, 370 : J. A.-H. Beng., I., 76 : Birdwood, 70 : Pereira Mat. Med., II., 485.

Rhododendron campanulatum, Don.—*Chimúl;* described by Brandis, 281. The leaves are exported to the plains, to be made into a snuff called *hulás-kashmíri*, useful in colds and headaches.

Ricinus communis, Linn.—Castor bean—*Rendi.* This well-known plant yields the medicinal oil used as a purgative, &c. Pharm., 201, 462 : O'Shaugh., 556 : Drury (U. P., 375).

Roylea elegans, Wall.—*Tít-patti, kauri.* The leaves are used as a bitter tonic febrifuge.

Rubia cordifolia, Linn.—*Majethi.* The natives consider the roots most useful in cases of poisoning, cutaneous eruptions, dysentery, and as a tonic to promote menstruation. Pharm., 118 : Drury (U. P., 379).

Rumex acutus, Roxb.—*Jangli pálak ;* described by Drury (F. P., III., 49). This plant has cooling properties : the leaves are applied to burns and the seeds are applied as the *bíj-band* of the bazars. *R. acetosa* is also widely distributed and known under the same vernacular name and also as '*Almora*,' whence the name of the capital of Kumaun, as Mussooree is derived from the vernacular name of *Coriaria nepalensis*.

S.

Salix tetrasperma, Roxb.—*Gar-byush ;* described by Brandis, 462. The bark in decoction is of some account as a febrifuge. Pharm., 213 : O'Shaugh., 606.

Saxifraga ligulata, Wall.; Var. *ciliata*, Royle. The roots of this and perhaps *P. Kurrua* (*antea*) and *G. Kurroo* (*antea*) are all exported to the plains as *pákhán-bhed* or *páthán-bhed* and *jintiána* and are used as a tonic in fevers and also in diarrhœa and coughs and as an antiscorbutic. The average annual export from the Kumaun forest division is about thirty maunds.

Sapindus detergens, Roxb.—*Kanmar, rítha;* described by Drury (U. P., 393). The nut is used externally in cutaneous affections and internally in epilepsy and headache and as an expectorant; also in the arts as a detergent. It is exported from the Kumaun forest division to the extent of about twenty tons per annum.

Scindapsus officinalis, Schott.—*Gaj-pípali, háth-ungliya.* The dried and sliced fruit has stimulant, diaphoretic, and anthelmintic virtues. Pharm., 250.

Semecarpus Anacardium, Linn., *F.—Bhiláwa, bhalian, bhála;* described by Hooker, II., 30. The acrid viscid juice between the laminæ of the shell possesses powerful caustic properties and is used as a vesicant: see further Pharm. 60: K. Dey, 105. The average annual export from the Kumaun forest division is about five maunds.

Sesamum indicum, Linn.—*Tíl.* See page 764. This plant furnishes the sesamum or sweet oil, used as a substitute for olive oil in native practice. Pharm., 151: Drury (U. P. 402): O'Shaugh., 479.

Sesbania ægyptiaca, Pers.—*Jaint;* described by Baker in Hooker, II., 114. The seeds have stimulant and emenagogue properties and are used in cutaneous diseases and itch: the leaves are used in poultices to promote suppuration, and the juice of the bark internally as an antiscorbutic.

Shorea robusta, Roxb.—*Sál;* described by Drury (U. P., 405). The resin (*rál* or *dhamar*) is an efficient substitute for pine resins in plasters: in native practice, the resin is taken internally in special diseases and applied as a styptic to wounds. Pharm., 33.

Solanum indicum, Linn.—*Katang-kári;* described by Drury (U. P., 408). The root is used in decoction in dysuria and in fevers and coughs: and when powdered as an anodyne. The juice of the leaves boiled with ginger is used to stop nausea. Pharm., 181.

Solanum tuberosum, Linn.—*Álu.* The tubers are occasionally used as a substitute for salep.

Solanum esculentum—*Baigan, bhatta.* See page 703. The leaves possess narcotic properties: nearly every species of this genus in Kumaun affords some aid to the native Materia Medica. Pharm., 181.

Spondias mangifera, Pers.—Hog-plum—*Ambara;* described by Hooker, II., 42. The bark is used in dysentery and a decoction of the wood in special diseases; the juice of the leaves forms an application in earache and the gum and fruit are eaten.

Sterculia urens, Roxb.—*Kuli, kulu;* described by Masters in Hooker, I., 355. The leaves and tender branches steeped in water yield a mucilaginous extract useful in pleuro-pneumonia in cattle.

Streblus asper, Lour.—*Sihora, rúsa;* described by Drury (U.P., 211). The milky juice is applied to cracked heels, sore hands, and has astringent and septic qualities. The bark in decoction is given as a lotion in fevers.

Symplocos cratægoides, Ham.—*Lod, lodh;* described by Brandis, 299. The leaves are considered astringent and are used in diarrhœa and as an application to fresh wounds and the bark in tanning. About nine tons are exported every year from the Kumaun forest division.

T.

Taxus baccata, Linn.—Yew—*Thúner, bráhmi;* described by Brandis, 539. The leaves are used in native practice in epilepsy and indigestion.

Tephrosia purpurea, Pers.—*Sarphonka;* described by Baker in Hooker, II., 123. The leaves and seeds possess astringent, tonic, febrifugal properties. The leaves of *T. candida,* the *lehtiya* of Kumaun, are used to poison fish.

Terminalia Chebula, Retz.—*Hár;* described by Drury (U.P., 431). This and other species of the same genus yield nuts much used in medicine and the arts. See Pharm. 89: K. L. Dey, 117: Birdwood, 34.

Tetranthera laurifolia, Jacq.—*Gar bijaur, meda-lakri;* described by Brandis, 379. The oil from the berries is used in rheumatism; the bark triturated in water or milk, or even dry, is applied to bruises and is given internally in infusion in diarrhœa; the leaves have a rich aromatic odour. Pharm., 88: O'Shaugh., 548.

Thalictrum foliolosum, D.C.—*Pila-jari, pengla-jari, barmat;* described by Hooker *f.* and Thomson in Hooker, I., 14. The roots are exported from Kumaun under the name *mamira* and are highly alued in ophthalmia and as an antiperiodic. Pharm., 5.

Tinóspora cordifolia, Miers—*Gulancha;* described by Hooker *f.* and Thomson in Hooker, I., 97. The stems yield the well-known extract known as *gulancha* or *giloi*, a much-esteemed specific in stings as well as infever and rheumatism. The leaves bruised and mixed with honey are applied to ulcers, with oil to the head in neuralgic affections, and in decoction for gout. The extract is made from the root by boiling for twelve hours and then straining and evaporating the water. The annual average export of the extract from the Kumaun forest division is about two maunds. Pharm., 9, 435.

Toddalia aculeata, Pers.—*Kanj;* described by Hooker, I., 497. The root-bark has tonic, stimulant, and anti-periodic properties. Pharm., 47, 442.

Trichodesma indica, R. Br.—*Ratmandi.* The natives consider it to be an antidote in snake-bites; the leaves are used as a poultice and in cold infusion as a purifier of the blood. Pharm., 158.

Trichosanthes palmata, Roxb.—*Indráyan;* described by Clarke in Hooker, II., 606. The roots and fruit are poisonous and are used in pleuro-pneumonia in cattle. Pharm., 96. *T. cucumerina*, Linn., gives seeds, tender shoots, and dried capsules, all of which are used as medicine. O'Shaugh., 351.

Trigonella Fœnum-græcum, Roxb.—Fenugreek—*Methi;* described by Baker in Hooker, II., 87. The seeds are stimulant, aromatic, and laxative, and are given in colds, coughs, diarrhœa, and special diseases.

Typha angustifolia, Linn.—*Boro.* The down of the ripe fruit is used as an application to burns and the lower succulent parts of the stem to clear muddy water.

U.

Urginea indica, Kunth.; *Scilla indica*, Roxb.—*Iskíl, kándri* or *kunda* of Bijnor and *ghesuwa* of Kumaun; described by Drury (U. P., 399). It is exported largely from the lower hills. The nauseous bitter young bulbous roots have expectorant and diuretic properties in small doses, and in large doses they are emetic and cathartic. Pharm., 241 : K. L. Dey, 104.

V.

Vallaris dichotoma, Wall.—*Dúdhi;* described by Drury (P. F. II., 198). The juice is applied to wounds.

Valeriana Hardwickii, Wall.—*Shumeo, asárun.* The roots are exported and are said to possess anti-spasmodic properties: when dry they are burned as a perfume, and are also used as a flavoring agent and to keep off insects from clothes. Pharm., 120.

Vernonia anthelmintica, Willd.—*Káli-jíri;* described by Drury (U. P., 449). The bitter seeds are powerfully diuretic and anthelmintic and are given in infusion in coughs and flatulency. Powdered and mixed with lime-juice they are used to expel vermin from the head, and mixed with oil in scabies and anasarca and in plasters for abscesses. Pharm., 126.

Viola serpens, Wall.—*Thungtu, banafsha;* described by Baker in Hooker, II., 184. The flowers are considered diaphoretic and laxative: the seeds are diuretic and the root emetic (like ipecacuanha) and purgative (Brown).

Vitex Negundo, Linn.—*Shiwáli, simáli, filfil-bári* (fruit); described by Drury (U. P., 452). The root and fruit have anodyne, diuretic, and emenagogue properties, and the leaves are given in colic. Exported from Kumaun. Pharm., 163: O'Shaugh., 484.

W.

Withania somnifera, Don.—*Asgand* (root); described by Drury (U. P., 355). The leaves are bitter and narcotic and are used in infusion in fever: the seeds coagulate milk and the roots are aphrodisiac and diuretic. Pharm., 182: O'Shaugh., 466. The seeds of *W. coagulans,* Don., have also sedative properties and are given in colic. Both are exported from Kumaun.

Woodfordia floribunda, Salis.; *Grislea tomentosa,* Roxb.—*Dhaula, dhái;* described by Clarke in Hooker, II., 572. The dried flowers are used as an astringent tonic in affections of the mucous membrane, hæmorrhoids, and bilious complaints. The leaves are also officinal in native practice. Exported from Kumaun.

Z.

Zanthoxylum alatum, Roxb.—*Tejbal, timúr;* Sansk. *jwarántika,* 'fever ender'; described by Hooker *f.* and Thomson in

Hooker, I., 193. The bark and seeds are used in native practice as a tonic in fevers and bowel complaints: the small branches are used as toothbrushes and the thorns as an application in toothache: the fruit is used to intoxicate fish. Supposed to possess generally stomachic and carminative properties. The average annual export from the Kumaun forest division is about half a maund. Pharm., 48.

Zingiber officinale, Ros.—Ginger—*Adrak, sonth*. This well-known plant yields the ginger of commerce, extensively used in medicinal preparations. See Pharm., 228.

B.—NARCOTICS AND SPIRITS.

Tobacco, opium, hemp, and the preparations made from them, are the principal vegetable substances used for their narcotic and intoxicating properties in these provinces, but to them we may add the various forms of alcohol obtained by distillation and the preparations of betel and areca. The use of tobacco in the plains is universal amongst males from their twelfth year, and the practice has so far entered into the social arrangements of the people that few matters of importance are discussed without the *hukka* being passed around. In the hills tobacco-smoking is becoming more common every year, and now, perhaps, all except a few Brahman families smoke tobacco either pure or mixed, and these even chew the leaf pounded with lime, a practice common to every caste. Opium is principally consumed by Musalmáns, and its use in the hills is very limited. The preparations of hemp are in great request amongst Hindús, and are much indulged in by Jogis and others of the wandering religious mendicant classes. Spirits are consumed chiefly by the lower castes of Hindús. Brahmans and Baniyas profess to hold it in abhorrence, and the use of it is forbidden to Musalmáns by the Koran. As a general rule these restrictions are observed, but still there are very many individuals of these classes who openly disregard the rules of their religion and many more who do so in secret. The statistics derived from the Excise Department would otherwise be inexplicable. Still, taking into account the quantities of opium, hemp, and spirits that must be consumed in a country like India without paying any license or contributing in any way to the revenue, there is only a moderate consumption on the whole. It has often been observed that you may pass through any fair or assembly, except during the Diwáli, the Hindu carnival, without seeing a drunken man, and there can be no doubt but that the consumption is very small and quite insufficient in the hills, at least, to have much effect upon the public health. Although hemp is produced in such quantities in Garhwál and Kumaun, the preparations from it are not a favourite form of intoxication in the hills and are seldom used by the permanent inhabitants.

TOBACCO.

Nicotiana Tabacum, Linn. Tobacco—*Tumáku, dhamáku.*

Tobacco.

Tobacco is raised in large quantities in the forest clearings along the foot of the hills, where the conditions necessary—a rich alluvial soil, warmth, and abundance of manure—exist. The last is furnished by the cattle which are sent there for grazing in immense numbers from November until May. In the Garhwál Bhábar the cultivation of tobacco is carried on by men of the gardener caste from the plains, who remain long enough to plant and gather the crop. The indigenous Bhuksas of these parts consider that they are prevented by their caste rules from growing tobacco, or rather are too indolent to undertake its cultivation. Further east all classes cultivate the plant, and great quantities are exported to the plains from the Kumaun Bhábar and the Taráí. The quality of the leaf is not so delicate as that of the better sorts of the plains varieties, but the quantity produced from a given area is greatly in excess of that raised elsewhere. In the hills, a far superior variety is cultivated from Jaunsár to the Káli, but not in quantity sufficient to be of much commercial importance. That grown on both banks of the Alaknanda near Srinagar in Garhwál is specially esteemed. The Kumaun vernacular names above given represent two varieties, *N. Tabacum* and the *N. rustica* or Latakia, which latter seems to have been grown in the hills from time immemorial, and when carefully prepared is palatable to Europeans. Dr. Stewart, writing of its cultivation in the western Himálaya, states that "more of it than of the ordinary kind can be grown per acre, especially as in many places the flowers are not plucked off, but are mixed with the leaves for smoking, and it brings in a greater price than the ordinary species. It is said to be much stronger than the latter and to be generally smoked mixed with a large proportion of it. Its qualities when smoked in the European pipe give assurance that, if properly cured, it would rival Turkish tobacco." Some efforts have been made lately by Mr. E. C. Buck to improve tobacco cultivation in Kumaun, but the experiments have failed and their history will be found in the annual report of the Department of Agriculture and Commerce.

The Sikhs, Wahábis, and certain Hindu sectaries are forbidden the use of tobacco by their religious guides, but the first console themselves with the preparations of hemp and the second use opium. The earliest mode of procuring and inhaling the smoke was to make two holes in the ground, in one of which the fire and tobacco were placed and a pipe connected the two. The smoker then crouched on the ground and sucked the smoke through the second hole. This method may still be seen in the hills. Another mode was to twist a leaf and smoke through the narrow end, still a favourite with coolies in the hills. An improvement was then effected by drawing the smoke through a bambu, and thus avoid the uncomfortable crouching position, and eventually the *hukka* was invented. The cocoanut served as the first form of the *hukka*, and though metal is now used for the receptacle for water and the original form has been modified, the cocoanut is still the basis of all the forms of the *hukka* from the elaborate and costly *pechwán* of the nobleman to the simple pipe of the cooly. Musalmáns seem to affect those *hukkas* that have stands, whilst Hindús adopt the round or oval shape, which are fitted chiefly to pass from hand to hand. In the plains tobacco is seldom smoked in its pure state (*sáda*), but is mixed with from a half to an equal weight of molasses, either of the sort known as *gúr* or that known as *shíra*, to which a little *saji*, or impure carbonate of soda, is added. In the interior of the hills, however, the pure leaf is generally the only sort procurable, but in the principal bazars the fashionable mixtures may be obtained. One of these in high repute amongst the wealthy is known as *khamera* and consists of a certain quantity of tobacco of the Latakias sort, to which is added the sence of the *Pandanus odoratissimus* or *keora*; the dried leaves of the musk-plant, *Delphinium brunonianum*; sandal-wood dust; a conserve of roses known as *gúl-kand;* the fruit of the *Zizyphus jujuba;* apple-preserve, cardamoms, and the wilted leaves and stems of the betel palm known as *pánri,* in certain proportions kept secret by each maker and which form his particular brand or manufacture. Snuffing tobacco, though not unknown, is rarely seen. Its use, however, as one of the ingredients of 'betel' should perhaps come under the head of chewing.

OPIUM.

Opium.

Papaver somniferum, Linn.—Poppy—*Post, posta;* juice of the capsule, opium; *afyún, afím.* A plant belonging to the natural order *Papaveraceæ.* The cultivation of the poppy is a Government monopoly and is chiefly confined to the plains. The capsules, whilst immature, yield by incision a juice which on solidification is known as the opium of commerce. When ripe or dried they yield an intoxicating liquor by inspissation. The use of the drug was known to the ancients, and some say that it was the *pharmakon nepenthes* of Homer. Dr. Royle considers that it was introduced into India from Persia, and in this suggestion he may, perhaps, be correct, as the common names for opium are of Persian origin. The *Aín-i-Akbari* refers to theo pium monopoly in Sirkárs Kora (Fatehpur district), Allahabad, and Gházipur in the time of Akbar, and we know that from time immemorial the opium poppy has been cultivated in Nepál and Kumaun.

The three principal preparations of poppy in use are the abkári or excise opium, *madak* and *chandu.* The first is supplied from the Gházipur factory and is sold at the rate of sixteen rupees per seer of eighty tolas. As a rule, *abkári* opium is taken in the form of pills, but many soak the preparation in water for some hours and drink the solution thus formed, leaving the impurities at the bottom of the cup: very moderate consumers take about one tola or 180 grains Troy or 11·662 grammes per month, and the average consumption of habitual opium-eaters may be set down at five tolas each per mensem. In some cases as much as two tolas a day are taken boiled in milk. Opium-smoking has of late years increased very much in these provinces. The results are the same as in other countries, the drug inducing stupor, reverie, and voluptuous listlessness. Still the individual can easily be roused to business, and, unless taken in excess, the effects are not more injurious or lasting than those attendant upon a too liberal indulgence in spirituous liquors. The temptations to excess are, perhaps, stronger in the case of opium, and with over-indulgence come sickness, constipation, indigestion, want of appetite, emaciation, impotency, and premature old age. In small doses as far as one grain, opium when eaten acts as a stimulant, increases the pulse in strength and frequency, and excites the mind by a happy train of thought. It is believed to promote digestion, and for this purpose it is taken usually in the afternoon or evening, so that its effect may come on before the time for the evening meal. This condition is however succeeded by drowsiness, thirst and loss of appetite, and the habitual eater then increases his dose, when after a smoke of tobacco from the *hukka* the excitement again begins and is followed by a period of stupor and eventually a profound sleep, "the pupils are slightly contracted, the pulse slow and full, the breathing slow, and the temperature of the body somewhat increased." Beyond four grains to healthy persons not accustomed to opium it may be considered to act as a poison. Milk is taken by opium-eaters to keep the bowels open, and as in the case of *bhang* and, indeed, spirits when once the habit of using the drug has been fixed, it is almost impossible to shake it off. Kahárs and men who have much trying physical labour to get through in a short space of time can, frequently, take large doses without apparent injury.[1]

Madak and chandu.

Madak and *chandu* are forms of opium extensively used in these provinces. In preparing them the opium is first reduced to a watery extract, which is then strained two or three times through cloth and afterwards boiled over a slow fire until it thickens somewhat. The impurities left in the process of straining are again washed and strained two or three times to extract any portions of the active principle which may remain. The refuse, called *joga*, is then thrown away and the residuum of pure extract of opium that remains is called *kimam* and forms the basis of both *madak* and *chandu*. One ser of excise opium yields a little more than half a ser of *kimam*. To make

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[1] I am indebted to several sources, official and private, for these notes on opium and hemp.

madak, the leaves of the guava, *pán*, or, in some cases, the rose are collected and cut into very fine pieces and then boiled in water. When they become soft they are strained in a cloth and dried and then fried on an iron pan over a slow fire. These leaves thus prepared are called *jesu*, and equal quantities of *jesu* and *kimam* form *madak*. This preparation is made up into small pills about the size of a pea, which sell in the retail shops for a pice each. The consumer buys these pills, breaks one of them into six to twelve parts, which are called '*chittas*,' each of which serves for one operation or whiff. The ordinary *hukka* is used, but the *chillam* or upper portion for receiving the drug and fire is much smaller. The *chitta* is placed on the *chillam* and lighted by a charcoal pencil, and the smoke is taken inwards in one inspiration and swallowed. The result is considerable pleasurable excitement, which as it begins to wear off is renewed by consuming another *chitta* until satiety is produced. One pill is sufficient to intoxicate a new smoker, but many consume a dozen pills with impunity.

Chandu.

The basis of *chandu* is the same *kimam* from which *madak* is made, but instead of leaves the half-burned ashes of the *chittas* of *madak* are mixed with the *kimam* in equal quantities and the resulting compound is called *chandu*. For this preparation there is a particular pipe made of wood and about twelve to fifteen inches long. A small brass or tin bowl is fixed towards one end and communicates with the stem by a small aperture. The *chandu* formed into a paste and made up into pills is placed in the bowl, and this is lighted from a lamp and gives a gurgling noise while burning. The smoker reclines on a pillow with his eyes closed, and the pipe is lighted by an attendant and refilled when necessary. Like the *madak*-smoker, the *chandu*-smoker takes in all the smoke arising from one application of the *chandu* by one deep inspiration and swallows it. After every inspiration there must be a rest, and the heated tongue is moistened by chewing sugarcane or by the application of a rag moistened in sherbet. Two or three applications are sufficient to affect a beginner, but there are many who can doze away over pipes of *chandu* the whole day. The effect of *madak* and *chandu* smoking is equally pernicious with opium-eating, with this difference that intoxication supervenes at a much earlier period, because the smoke containing the active principle of the opium is directly absorbed by the blood in the lungs, and being carried into the circulation acts, at once, on the brain; whilst in eating opium the process of solution, absorption, and digestion is much slower. Muhammadans are by far the greater smokers and eaters of opium as compared with the Hindús, and they make up by indulgence in this vice for the prohibition of spirituous liquors. Love of sexual intercourse has much to do with inordinate indulgence in opium, and for a time, like the preparations of hemp, it acts as a powerful aphrodisiac, but in the end it induces impotency and leaves the opium-drunkard a physical and moral wreck, utterly careless for the present or the future and a mere semblance of a human machine.

HEMP.

Cannabis sativa, Linn.—Hemp—*Gár-bhanga* (female plant), *phúl-bhanga* (male plant). (See FIBRES *postea*.)

Hemp.

The principal parts of the hemp that are used as intoxicating agents are the *charas*, *gánja* and *bhang*, or *sabji* and their preparations. The best *charas* is obtained from the female plant and consists of a resinous exudation from the leaves, stems and seeds when ripe, and is collected from them by rubbing them in the hands or on the naked thigh or by scraping the resin from the plant with a blunt iron knife. The quantity and quality of this resin differs with the soil and locality. In some places the plant developes a woody tissue, whilst in others the bark splits and a resin is secreted. In the plains in many places the hemp plant yields excellent *gánja*, but neither *charas* nor *bhang*; and again in the hills the *charas* is the principal product. The best qualities of *charas* are imported from Yárkand, Bukhára, and Afghánistán. In former times only the pure resin collected by the scraping process was imported, but now a system of manufacture has sprung up by which a much larger return is effected. When the plants have arrived at maturity, which is known by the bark commencing to split, they are cut down and soaked in water and when well moistened the resinous juice is pressed out. This is then boiled and reduced to the consistence of a paste, in which form it is imported by the Afghán fruit-sellers. It contains, in addition to the resin, much of the juice of the plant, its colouring matter and other foreign substances, and is altogether inferior to the resin collected by the old scraping process. The Kábulis sell this preparation to the contractors at about one and a half rupee per ser, and they again to the licensed vendors at from four to five rupees per seer, and the latter retail it at about two *chhattáks* for a rupee or eight rupees a seer. The drug is consumed in the following manner :—About the weight of a two-anna silver piece or 22 grains Troy is taken and covered up with twice its weight of prepared tobacco in the shape of a ball. This is dried over a charcoal fire, and during the process the *charas* melts inside. The dried ball is then reduced to powder and mixed with tobacco is placed on the *chillam* of an ordinary cocoanut *hukka* and smoked in the same way as tobacco. *Charas* seems to be a milder form of the drug than *gánja* and is used by the better class of people and those who do not care for intoxication pure and simple.

GÁNJA.

Gánja.

Gánja consists of the dried flower heads and smaller leaves from which the resin has not been removed. It yields to alcohol twenty per cent. of resinous extract composed of the resin (*charas*) and green colouring matter. Distilled with a large quantity of water traces of essential oil pass over, highly odoriferous of the drug. The colour of the bundles of *gánja* is dusky green, the odour narcotic and the touch adhesive. The *gánja* produced in Kumaun and Garhwál is considered of little value and is not, so far as I am aware, exported. The *gánja* consumed locally is imported from the lower districts. Two sorts of *gánja* are sold in these provinces—the *pattar* and the *bilúchar*. The *pattar* is imported chiefly from Holkar's territories and is of quality inferior to the Bengal *gánja*. It is purchased at from five to six rupees per maund in Indúr in the rough state, including the stalks and useless leaves, and also pays a duty of about four annas per maund on exportation to British territory. The farmer of the drug revenue pays the cost of carriage and sells it to the licensed retail vendors at from Rs. 20 to Rs. 22 per maund. The retail sellers separate the real *gánja* from the rough plant and throw away the refuse, which amounts to from five-eighths to two--thirds of the whole, or in one maund of rough plant only thirteen to fifteen sers of real *gánja* will be found. This sells at from three to four rupees per ser, and about one quarter of a ser will form a month's supply for an ordinary smoker. This *pattar gánga* is chiefly consumed by the lower classes of Hindús, and especially by all the mendicant sects of Bairágis, Nágas, Sanyásis, &c.

The *bilúchar* variety is imported from Lower Bengal and is far superior to the *pattar*. It is grown in the Rajsháhi district and sells there in the rough at from Rs. 18 to Rs. 22 per maund. The Bengal Government charge a duty of from Rs. 2 to Rs. 2-8 per ser, or Rs. 100 per maund, on all exports of *gánja* to these provinces. The farmers of the drug revenue separate the real *gánja* from the rough plant and sell to the licensed retail vendors at from Rs. 10 to Rs. 12 per ser, and the latter retail the drug at one rupee per chhaták (1oz. 17dwt. 12grs. Troy), so that Bengal *gánja* is as dear as excise opium in these provinces. One or two chhatáks are sufficient for a month's consumption to an ordinary smoker. The Bengal *gánja* is much stronger than the *pattar* variety, so that a much smaller quantity produces the same result. It is used only by the better classes, being the more expensive of the two. *Gánja* is not in general used so much as tobacco. Kahárs when they complete a portion of their journey often take it as a stimulant, and others with weak digestions smoke a little before a meal to excite a feeling of hunger and promote digestion. It may serve as a stimulant for the time, but its after-effects are lassitude and depression. *Gánja* is also used as a sedative to promote sleep, which it does after an interval of excitement by intoxication.

Gánja is prepared for smoking by taking a portion of the dried leaves, say 20 grains in weight, in the palm of the left hand; these are rubbed with the right thumb, a few drops of water being added to moisten it. Then an equal quantity of dry but soft tobacco leaf is added, and the whole is formed into a paste. This is then cut into thin layers with a knife and again rubbed and pressed into a paste with more water. The compound when well mixed is again sliced, and the process is continued two or three times until the *gánja* and tobacco are thoroughly amalgamated. It is then smeared with the fingers over a very narrow, small, earthen *chillam*, and a small cake of lighted charcoal is placed on the top. The *chillam* is placed on the ordinary hukka, consisting of a hollow wooden cylinder fitted into a dry coconut shell which is half full of water; another cylinder attached to the middle of the coconut forms the stem through which the smoke is swallowed. *Gánja* smokers are, as a rule, sociable, and the pipe is passed around after each one has had one good pull at it. Each smoker swallows the smoke, which conveys the active principle in that form to the lungs and stomach. With strong Bengal *gánja* it is difficult to retain all the smoke inspired at a single time, and a cough usually interrupts the operation. This custom is as much due to economical considerations as to good-fellowship, for no one could smoke time after time and the *gánja* keeps burning away all the same. One dose of *gánja* is quite sufficient to give a moderate feeling of intoxication to four or five persons. To those unaccustomed to it a single inspiration produces giddiness and even stupor for a time, whilst habitual smokers can take their turn for half an hour. Heaviness, laziness and agreeable reveries ensue, but the person can be readily roused and perform routine duties. As in the case of opium, *gánja* is often made use of as an aphrodisiac.

BHANG.

Bhang.

Bhang comprises the larger leaves and capsules of the hemp without the stalks. In these provinces there are three varieties of *bhang* in common use, *viz.*, the Hardwár *bhang* which comes from Garhwál, the Oudh which comes from the Gonda district, and the Panjábi which comes from Julandhar. Of these the Oudh variety is the strongest and therefore the best, so much so that one part of it intoxicates as quickly as two parts of the other varieties. The *bhang*-producing hemp grows wild and is sold in the rough with the stalks and refuse leaves at about one rupee per maund in the producing districts, but to this must be added the cost of carriage. The farmer of the drug revenue sells the cleaned plant to the licensed vendors at from ten to fifteen rupees per maund according to the distance from the base of supply. The latter retail the drug to consumers at eight annas per ser or Rs. 20 per maund. The names *sabji* and *sidhi* are, also, applied to *bhang* in its green state, and *májum* is a conserve of *bhang* which is noticed hereafter.

Bhang is prepared for use by soaking the dried leaves for a time in cold water and carefully washing and freeing them from all sorts of impurities, such as dust, seed, kunkur, and the stalks and stems. The leaves are then bruised in a mortar or on a flat stone and made into a thick paste. The paste is then ready for use, and when required is diluted with water according to taste and the solution is drunk. Many persons mingle spices with the paste during the pounding operation, such as black pepper-corns, aniseed, cloves, cardamoms, sugar, and melon and cucumber seeds, but the pepper forms the principal ingredient. An ordinary drinker will consume one ser of *bhang* or eight annas worth per mensem. Most Hindús who do not indulge in wine, such as Brahmans, Baniyas and the like, take *bhang*. It is the special drug of the Hindu mendicant classes as *madak* is affected by the Musalmán fakírs. The Chaubes of Muttra, the Pragwáls of Allahabad, and the Gangaputras of Benares, are noted for their indulgence in excessive *bhang*-drinking. In the Panjáb, the Bhangi *misl*, or sub-division of the great Sikh confederacy, was so called from the real or fancied fondness of its members for the use of the drug. *Bhang* taken in moderate quantities is exhilarating and tonic: it creates an appetite and promotes digestion. In large doses, when the intoxication is severe, its effects are very remarkable: the patient is raised to a state of ecstacy and cares neither for his own life nor the lives of others. Sometimes he cries in a delirium of joy and then again breaks out into exulting laughter. Even in moderate doses its effects are noteworthy. Dr. O'Shaughnessy made several experiments to ascertain the effects of the drug on men and animals, and in the course of them several of his pupils commenced experiments on themselves which are thus reported:—"In all, the state of the pulse was noted before taking a dose, and subsequently the effects were observed by two pupils of much intelligence. The result of several trials was that in as small doses as the quarter of a grain, the pulse was increased in fulness and frequency; the surface of the body glowed; the appetite became extraordinary; vivid ideas crowded the mind; unusual loquacity occurred; and with scarcely any exception great aphrodisia was experienced. In one pupil, Dinonath Dhar, a *retiring lad of excellent habits, ten drops of the* tincture, equal to a quarter of a grain of the resin, induced in twenty minutes the most amusing effects. A shout of loud and prolonged laughter ushered in the symptoms, and a transitory state of cataleptic rigidity occurred for two or three minutes. Summoned to witness the effects, we found him enacting the part of a Raja giving orders to his courtiers; he could recognize none of his fellow-students or acquaintances; all to his mind seemed as altered as his own condition; he spoke of many years having passed since his student's days; described his teachers and friends with a piquancy which a dramatist would envy; detailed the adventures of an imaginary series of years, his travels, his attainment of wealth and power. He entered on discussions on religious, scientific, and political topics with astonishing eloquence, and disclosed an extent of knowledge, reading, and a ready apposite wit which those who knew him best were altogether unprepared for. For three hours and upwards he maintained the character he at first assumed, and with a degree of ease and dignity perfectly becoming his high situation. A scene more interesting it would be difficult to imagine. It terminated nearly as abruptly as it commenced, and no headache, sickness, or other unpleasant symptom followed the innocent excess. Dr. Goodeve and more than thirty students were present at this occurrence. In the symptoms above described, we are unavoidably led to trace a close resemblance to the effects produced by the reputed inspiration of the Delphic Oracles; perhaps it would not be very erroneous to conclude that it was referable to the same kind of excitement."

MÁJUM.

Májum.

Májum or conserve of *bhang* is a preparation much affected by the better classes. In one maund of *májum*, as used in these provinces, there are three sers of *bhang*, two sers of *ghi* or clarified butter, and thirty-five sers of sugar. It is prepared in this way:—take three sers of clean *bhang* and soak it for a night in cold water; next morning take out the *bhang* wash it well and put it into a basket, to allow the water to drain off. Then place a large shallow iron-pan on a slow fire and throw into it about two and a half sers of good *ghi*. When this melts and begins to boil throw into it the *bhang* and fry it until it becomes crisp. Then add water and boil for some hours until the *bhang* becomes soft and pulpy. Then strain through a cloth and pound in a mortar until a paste is made. You next take a maund of sugar and put it in the pan, adding a sufficient quantity of water to melt it. The sugar is then boiled, and while boiling is clarified with milk; when properly purified the *bhang* paste is added in small quantities at a time and carefully stirred to ensure its mixing with the sugar. When thoroughly amalgamated, the compound is taken out and spread on flat brass plates about an inch thick, and when this hardens by drying, it is cut into small square pieces with a knife. The quantity of *ghi* and *bhang* make up for the loss in clarifying the sugar, and the result is one maund of *májum*. The confection costs about Rs. 18 to 20 per maund and is sold to the licensed vendors at Rs. 40 per maund, and these latter retail it at one pice per square to their customers. Two squares are sufficient to produce a moderate amount of intoxication to an ordinary person. People seldom get used to taking *májum* daily, and it is generally taken for purposes of pleasure and as an excitant to debauch.

Another mode of preparation is as follows:—Four ounces of *sidhi* and an equal quantity of *ghi* are placed in an earthen or well-tinned vessel, a pint of water is added, and the whole is then warmed over a charcoal fire. The mixture is constantly stirred until the water all boils away, which is known by the crackling noise of the melted butter on the sides of the vessel; the mixture is then removed from the fire, squeezed through cloth while hot, by which an oleaginous solution of the active principle and colouring matter of the hemp is obtained, and the leaves, fibres, &c., remaining on the cloth are thrown away. The green oily solution soon concretes into a buttery mass, and is then well washed by the hand with soft water so long as the water becomes coloured. The colouring matter and an extractive substance are thus removed, and a very pale green mass, of the consistence of simple ointment, remains. The washings are thrown away, for if used they are intoxicating and produce constriction of the throat, great pain, and very disagreeable and dangerous symptoms. The operator then takes two pounds of sugar, and adding a little water, places it in a pipkin over the fire. When the sugar dissolves and froths, two ounces of milk are added; a thick scum rises and is removed, more milk and a little water are added from time to time, and the boiling continued about an hour, the solution being carefully stirred until it becomes an adhesive syrup, ready to solidify on a cold surface; four ounces of new milk, dried before the sun, in fine powder are now stirred in, and lastly the prepared butter of hemp is introduced, brisk stirring being continued for a few minutes. A few drops of atar of roses are then quickly sprinkled in, and the mixture poured from the pipkin on a flat cold dish or slab. The mass concretes immediately into a thin cake, which is divided into small lozenge-shaped pieces. A ser thus prepared sells for four rupees. One drachm by weight will intoxicate a beginner and three drachms one experienced in its use. The taste is sweet and the odour is very agreeable.

The pure resin of the hemp is very soluble in alcohol and ether, partially soluble in alkaline and insoluble in acid solutions. When pure it is of a blackish grey colour, hard at 90°, softens at a higher temperature and fuses readily. It is soluble in several volatile and fixed oils. Its odour is fragrant and narcotic; the taste is slightly warm, bitterish and acrid. The late Sir W. O'Shaughnessy gives[1] a very interesting historical account of the plant and of the experiments made by him on its properties and uses. Mention of the drug is made by the Sanskrit, Arabian, and Persian writers at a very early date. Some trace a reference to it in the *gánja* mentioned by Manu, but Williams refers the name to the *Abrus precatorius*, whilst giving the adjective *gánjakini* to anything made of hemp. It is noticed as early as 658 H. (1259 A.D.) by Musalmán writers, and was early introduced into Egypt, where, under the name of *hashish*, it is still eagerly consumed by the lower classes. As in India, its use by religious zealots has led to terrible scenes of slaughter and rapine, so in Egypt, the sect most addicted to it was called the Hashishin or Assassins.[2] Throughout the east, from an early period, it has been used as a medicine and now forms an article of the Indian Pharmacopœia, prescribed in cases of tetanus, hydrophobia, cholera, delirium-tremens, and neuralgia. A careful chemical examination of the different forms of Indian hemp and their preparations is still a desideratum and worthy the attention of the many able chemists residing in India.

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[1] Bengal Dispensatory, 570-604; Waring's Dispensatory, 210. [2] See Yule's Marco Polo, I, 132.

SPIRITS.

Spirits.

The ordinary country spirit is manufactured in all the hill districts. It is made from *shíra* and *gúr*, two forms of the products of the sugarcane. These are placed in a covered tub with water, barley, and certain spices and allowed to ferment. When fermentation has taken place, the tub is filled with water and after two or three days the mixture is ready for distillation. The still in common use is the ordinary rude apparatus of two vessels of metal connected by a tube of bambu. In one the liquor to be distilled is placed and a fire lighted under it; the liquor passes through the tube into the other vessel which is kept cool by being placed in water. This once distilled liquor, known as *tharra*, is of two qualities: the *rási* or weaker and the *phúlka* or strong spirit. If re-distilled the product is known as *makattar*. The process of fermentation takes from ten to twelve days in the hot-weather and double that time in the cold season. The liquor produced from molasses is dearer, but much stronger than that produced from the *mahua*. By one distillation, however, it seldom reaches to 50° under proof by the Syke's hydrometer, but by several distillations spirits even above London proof may be obtained. In Kumaun, as a rule, the use of spirituous liquors is confined to the lower castes, though gradually spreading to the better classes; but in Garhwál the Hindús are less scrupulous, and, according to Traill, all but a few Brahman families drink spirits manufactured there from rice or barley. At the same time, however, they will not drink the spirits manufactured in the plains or after the plains method, objecting both to the materials employed and the caste of the makers. In Garhwál the spirit is made by Rajpúts, not Kalwárs as in the plains. A coarse spirit is also manufactured from *mandua*, and the Bhotiyas prepare another called *dáru*.

BETEL.

Chavica Betel, Miq.—*Pán.* The *pán* is imported from the plains. The leaves are used in chewing and are membranaceous or the adult ones coriaceous, shining above, glabrous on both sides; the inferior ones ovate, broadly cordate, equal-sided; slightly unequally cordate or rounded at the base, five to six nerved. The ingredients in the masticatory in common use are the *pán* leaves;

supári, the nut[1] of the *Areca catechu* or betel-nut palm, a native of the eastern islands and cultivated in Lower Bengal and Travancore; *chúna* or lime; and *kath* or catechu, the produce of the *khair* tree (*Acacia catechu*). Women usually add a small quantity of tobacco to the compound and many add the small cardamom. The average quantity consumed by *pán*-eaters is about five leaves a day, costing about one and a half pice, or 2¼ farthings. The mixture is pleasant and refreshing, but like other things its inordinate use is injurious to the digestion. Marco Polo mentions the use of the plant, which he calls *tembul*; the name of the caste still employed in its sale and preparation is Támboli. The shreds of the unused leaves and the juice of the stalks (*pánri*) are made use of in the preparations of tobacco for smoking.

III.—VEGETABLE SUBSTANCES USED IN MANUFACTURES.

A.—OIL-SEEDS.

The only oil-seeds of importance grown in the Kumaun division and the tract under the hills are the rapeseed and linseed of commerce. The medicinal and other oils have no great value as articles of export and are only procurable in very small quantities. The Bhábar exports great quantities of rapeseed, for which the climate and soil appear to be eminently suited. As so much confusion exists in the synonymy of the mustards, the botanical description of the more important species is given here to aid in distinguishing it.

Brassica nigra, *Koch*. Hook, Fl. Ind., I., 156. *S. erysimoides*, Roxb., Fl. Ind., 499—*Asl rái, ghor rái, makara rái*, and *banárasi rái* of Kumaun and *sarshaf* of the hospitals, where the seeds are used for poultices and also in veterinary practice. The leaves are used as a cress. The oil is used chiefly for medicinal purposes.

Brassica campestris, *Linn.*, Hook. Fl. Ind., 156. *S. dichotoma*, Roxb., Fl. Ind., 497.

Erect, lower leaves lyrate, upper auricled, flowers corymbose, beak of pod flat, seedless. An erect, stout, simple or branched, glabrous or slightly hispid annual, 1-3ft. high. Leaves large, petioled, more or less pinnatifid, upper oblong or lanceolate. Flowers large, bright yellow, pedicels ¾in., ascending or spreading. Pods 1½-3in., glabrous, sub-erect; valves with midrib and flexuous veins. Seeds small, smooth, pale or dark.

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[1] This nut is yellow, oval, the size of a small egg, enclosing an oily kernel like a nutmeg, conical, rounded, pointed and marked with white and reddish veins; inodorous, but of a very astringent taste. It contains a large protion of tannic and gallic acids.

Var. *dichotoma*, Roxb., the *jariya, jadiya* of the hills and *lahota laita* of the Bhábar, where it is grown only in a few valleys in Kota, and *káli sarson* of Northern India.

Var. *glauca*, Roxb., the *rára, ráda, rára-sarson* of Kumaun, *banga-sarson* of Dehra Dún, and *píla-sarson* of Oudh and Rohilkhand: seldom grown in the Bhábar, as it yields a crop good in quality, but poor in quantity.

Var. *glauca*, Royle, the *dain, dáin*, and *lai* of Kumaun and Garhwál: sometimes *khetiya, tori*, and *toriya* of Northern India, where this variety is in general cultivation: grown very largely in the Bhábar.

The *jariya* variety is sown in the beginning of September in fields where manure has been lying. The stalks are cut from the root and when dry the grain is threshed out and the oil is expressed in the common *kolu* or oil-press. It is a favourite crop near Almora. The *rára* variety is grown all over the hills in small quantities only, as it requires much manure and is liable to injury from hail. It is sown in first-class unirrigated land in November-December and gathered in April. It yields about three maunds of oil to an acre. The *lai* variety is cultivated all over the hills up to 11,000 feet and is the staple mustard crop of the Bhábar. These three varieties are grown as oil-seeds and afford the rape-seed of commerce.

Brassica juncea, H. *f. et* T.: *Sinapis juncea*, Linn.—*Rái, sarson.* There are several varieties of this species. The *S. ramosa*, Roxburgh (498), is the *barlái* of Kumaun, and the *S. rugosa*, Roxburgh (499), is the *bádsháhi-lái* or *bhotiya-lái* introduced by the Gorkhális from Nepál. Both these varieties are cultivated chiefly for their leaves, which are eaten as a vegetable cooked and dressed with spices and clarified butter. The brown seed of *B. juncea* proper, however, yields an oil that possesses properties similar to those of *B. nigra*, and for which the seeds may be substituted in the preparation of poultices. *Eruca sativa*, Linn., the *dúa* and *chára* of Kumaun, is cultivated as a vegetable and also for the oil from its seeds, which is less pungent than mustard-oil. It escapes frequently in cultivated tracts, coming up accidentally with other crops.

Linum usitatissimum, *Linn.*—*Flax; seed* is known as *linseed*—*Alsi, tisi.* An annual belonging to the natural order *Lineaceæ* ; seeds oval, pointed in shape, compressed, with a sharp margin ; brownish coloured ; smooth and shining outside, but white internally. The native country of the flax plant is not known, though it has been thought to be indigenous to Central Asia and has been cultivated for centuries in India. The Indian seed is better for oil and the European seed for fibre. In these hills it is cultivated only for the oil and the oil-cake, which is used as fodder for cattle.

Sesamum indicum, Linn.; the seed is known as *til* and the oil as *mitha tel.* An annual belonging to the natural order *Pedaliaceæ.* There are two varieties known to commerce, the black and the white grain, and a third parti-coloured is found in these provinces. The white-grained called *tili* is cultivated in Kumaun, and the black-grained variety grows wild there and in the Bhábar. As a rule the fresh seed is expressed at once, but in many cases where a finer oil is required the dark colouring matter of the epidermis is removed by bleaching in hot water or washing in cold water several times. The oil produced from these whitened seeds is considered a useful substitute for olive oil in the preparation of medicines and in manufactures. The mode of extracting the oil is usually the same in the hills and Bhábar. The seed is first sifted, cleaned and dried, and then put into a *kolu* or press worked by hand or by oxen. A little water is added, and after some time the oil runs out. The oil is then strained or allowed to stand in shallow vessels, when the impurities sink to the bottom. Every three parts of good seed yield one part of oil, which has risen in price much of late years and renders *til* a very valuable crop. Besides its use in painting and medicine, the oil is burned in lamps, forms a substitute for salad-oil in cooking, and is the basis of most of the perfumed oils in use in India. The last are made by adding one weight of flowers to three weights of oil in a bottle ; the mixture is then cooked and exposed to the sun for forty days, when the oil is supposed to be sufficiently impregnated for use. The seeds of sesamum are largely used in religious ceremonies by Hindús, and mixed with sugar in the form of a sweetmeat (*ladu*) forms an appropriate present for old and young at all festivals.

Ricinus communis, Linn.—Castor bean—*Ind, rendi, arand.* This bean is commonly cultivated in small quantities in the lower valleys for home consumption.

Bassia butyracea, Roxb.—*Chiúra* (Kumaun); the butter made from its fruit is called *chiúra-ka-phua* and *phulel*; the *phulwa* and *phulwara* of Almora. A tree belonging to the natural order *Sapotaceæ*, 30-40ft.: leaves obovate, tomentose beneath : corolla 8-cleft : stamens 30-40 on longish filaments : pedicels aggregate, and are, as well as the calyx, woolly: drupes oval : flowers smallish, white. Roxb. Fl. Ind., II., 527; Reprint, 411 : Don. Fl. Nep., 146. Flowers in November. It occurs abundantly in the valley of the Kálí, where the bees feed on its fragrant flowers and those of the *jaundela* (*Æchmanthera Wallichii*) : hence Sor honey is so esteemed (see page 715). The timber is of little value, the principal product being the 'vegetable butter' extracted from the fruit and which is used as a pomade or cold-cream, also in rheumatism and stiffness of the limbs. Its medicinal properties deserve further investigation (Ind. Phar., 131). It dissolves readily in alcohol, burns without smoke or smell, and makes good soap and candles. Solly's analysis gives solid oil, 34 parts of fluid oil and 6 parts of vegetable impurities (J. Agri.-Hort., Ben., I., 23). It retains its consistency up to 95° and completely melts at 120° and does not become rancid by keeping. The *phulel* is produced by bringing the kernels of the fruit into the consistence of cream, which is then put into a cloth bag with a moderate weight laid upon it and left to stand until the oil or fat is expressed, which becomes immediately of the consistence of lard and is of a delicate white colour (see Roxburgh's description in As. Res., VIII., 477; and Drury, U. P., 67). *B. latifolia*, Roxb., *mahua*, occurs occasionally in the Bhábar and affords an oil from its seeds, but is of little economical value here.

The medicinal oils, as already noticed, consist chiefly of sesamum oil impregnated with the various herbs and flowering plants that they are named after or with the different gum-resins. Oils in small quantities made from tea, poppy, and many fruit trees and flowering shrubs were exhibited at Agra in 1867, but owing to the imperfect arrangement of the catalogue no data exist for estimating their value commercially or ascertaining their uses.

B.—DYES AND TANS.[1]

The dyes of vegetable origin in these provinces may be broadly divided into two classes: first, those produced from plants specially cultivated for the purpose; and second, those obtained from plants or trees growing wild or which are cultivated on account of some other product. There are no representatives of the first class in the hills, and to the second class belong turmeric and the great mass of dyes exported from the hills as a portion of the minor forest produce, but which are of little commercial value. The tanning materials of vegetable origin are all the products of trees and plants that grow wild and afford a valuable assistance to the supply of similar materials found in the plains. In neither case, however, does it appear that much can be done in the way of making further use of these substances until their character and qualities have been more thoroughly examined. At present it is believed that, with few exceptions, they do not present any such features as would give good grounds for the hope that they might become of much importance or objects of a regular trade, but until competent persons undertake their investigation it is unnecessary to discuss the finality of this verdict. The local market for either tans or dyes is inconsiderable, and the plains' markets are now filled with the products of the latest discoveries in Europe which in cheapness and quality far surpass the hill materials and are now ousting the local dyes from general use. A demand for bark for tanning purposes will, however, always exist as it would not be profitable to import it.

DYES.

(a.)—Extracted from the root.

Rubia cordifolia, Linn.—Madder—*Majethi, manjit.* It should be remembered that the vernacular name *majethi* is sometimes given in Kumaun to *Impatiens Balsamina*, which also yields a red dye, but it is properly applied only to *Rubia*. There are two species, *R. Manjistha*, Roxb. (1,374), abundant 4,000-9,500 feet with black fruit and deep red flowers, and *R. cordifolia*, and both are distinct from the European madder (*R. tinctorum*) and yield a brighter dye, but whether owing to inherent defects or improper appliances the dye is not so durable. It is in common use with the Bhotiyas and gives with alum a reddish-brown colour. Some attempts have been made to introduce the cultivation of the European madder plant, but they were neither continuous nor exhaustive, though successful in Afghánistán and apparently also in Kumaun. The average annual export from Kumaun is about ten maunds.

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[1] For more detailed information on this subject, see "Economic Products of the North-Western Provinces, Part III," Allahabad, 1878.

Curcuma longa, Roxb.—Turmeric—*Haldi* (root). See *Condiments*. This root is chiefly grown as a condiment, but one variety which when cut has a rich unctuous appearance also yields a yellow dye. When it comes into contact with an alkali it turns red, and is seldom used except for the commonest purposes and by the poorer classes.

Berberis aristata, D. C.—*Chitra, totar*. The bark and root of this species and *B. Lycium*, known as *kingora-ki-jar* or *dárhald*, *dárchob*, yield a yellow dye. They are both common in the Himálaya of these provinces. The colouring principle is found chiefly in the root and affords an excellent dye for leather. The average annual export from the Kumaun forest division is not more than two maunds.

Mariscus cyperinus— *Nagarmotha, panmotha*. The roots are used in dyeing to give a scent to the cloth and also in medicine. Some identify *nagarmotha* with *Cyperus juncifolius*.

Datisca cannabina, Linn.—*Akalbír* (root), *bajr-bhanga* (plant). The yellow root is exported to aid in dyeing red and is also used in medicine,

Hedychium spicatum, Em.—*Kachúr-kachri*, *Kapúr-kachri*. The root has a strong perfume and is used in dyeing to scent cloth, also to scent tobacco and as a medicine. The average annual export from the tract between the Ganges and the Sárda is about ten tons.

(*b.*)—*Extracted from the bark or stem.*

Acacia Catechu, Willd.—*Khair* (the tree)—Catechu, cutch—*kath*, *katha* (the dye). The manufacture of catechu or cutch, or terra japonica as it is variously called, has gone on from time immemorial at the foot of the hills. The men employed are of the Dom caste and are called Khairis from the vernacular name of the tree. They continue at work from November until the rains set in and are aided by their families. Madden's description of the manufacture still holds good. He writes :—"One portion of the Khairis is constantly employed in cutting down the best trees, and for these they have to search far in the jungles; only those with an abundance of red heart-wood will answer. This is chopped into slices a few inches square. Under two large sheds are the furnaces, shallow and with a slightly convex clay roof, pierced for twenty ordinary sized earthen pots. These are nearly filled with chips, and water is then poured in and boiled until the contents of twenty will only fill two pots. This operation takes place in about an hour and a half. The liquor resembles thin light port, and the *katha* crystallizes on leaves and twigs thrown into it for the purpose. Each pot yields about a seer of an ashy white colour. The work is carried on for twenty hours out of the twenty-four by relays of women and children; the men merely preparing the wood, which, after being exhausted, is made use of as fuel." The best samples of *kath* are clean and whitish or of a pink colour, but some are dirty and mixed with foreign matter. In 1848, *kath* was worth six rupees a maund in the forests. In the Dún the *kath* is not allowed to crystallize on twigs, but is poured into clay moulds and made into cakes. *Kath* is used as an ingredient in the prepared *pán* so commonly chewed by natives and gives the red colour to the saliva. As a dye it gives brown tints and is largely used for colouring sails and fishing-nets. The average yearly export from the forests between the Ganges and the Sárda is about 120 tons, though but little catechu is now made west of the Rámganga. The bark of this tree is also used in tanning.

Taxus baccata, Linn.—Yew.—*Thaner*, *geli*, *gullu*, *lúst*. The bark yields an inferior red dye only used in the Bhotiya parganahs.

Symplocos cratægoides, Ham.—*Lodh, lod.* The bark and leaves yield a yellow dye and are used in combination with madder. The average annual export from the tract between the Ganges and the Sárda amounts to about twenty tons, of which about nine tons come from the Kumaun forest division.

Alnus nepalensis, Don.—Himálayan alder—*Udis, kunch, koish.* The bark is used in tanning and in dyeing red and is one of the ingredients in the native-made red ink.

(c.)—Extracted from the leaves.

Justicia Adhatoda, Linn.—*Arúsa.* This plant yields a yellow dye from its leaves by boiling them in water in the proportion of 10lb to 16lb until half the water has evaporated. In combination with indigo it gives a dark-blue green. The leaves are procurable at from 20 to 25 seers per rupee.

Cinnamomum Tamala, Nees.—*Dálchíni, kirkiriya, sinkauri,* and leaves *tejpát.* The leaves are more commonly used as a condiment (see *Condiments*), but they are also of use in calico-printing in combination with myrobalans. The average annual export from the tract between the Rámganga and the Sárda is about 33 tons of the leaves and 24 tons of the bark.

(d.)—Extracted from the fruit-rind.

Acacia arabica, Willd.—*Babúl.* This tree does not flourish in the Kumaun Himálaya, though stunted specimens are found as high as 3-4,000 feet. It occurs, however, in the drier tracts along the foot of the hills and yields a black dye from the pods, which are simply pounded and boiled. The gum is also used extensively by dyers and calico-printers and the bark in tanning.

Mallotus phillipinensis, Müll—*Kamela, rúína, roli.* The ripe fruit of this small tree is covered with a powder that yields an orange dye. It is commonly used in dyeing silk and wool and gives a rich flame colour of great beauty and permanence and is one of the best of its kind. It sells at from 3 to 4 seers per rupee. Stewart writes :—"The ripe capsules are gathered off the bushes in March, and after being allowed to lie in a heap for a few hours are rubbed and kneaded with the feet on the ground to remove the powder, the broken capsules being then separated by winnowing, sifting, and picking. One man will collect about a seer of the powder in a day, which is bought by the dealers at five seers for a rupee. The above process will quite account for the commercial *kamela* not being very clean; but besides this, although the Bhuksas, who gather it, deny that any adulteration takes place, it is said never to reach the plains' market in its comparatively pure state." The substances added are stated to be the pounded bark of *Casearia tomentosa*, Roxb., the *chíla* of Garhwál, and the red powder on the fruit of the *Ficus indica*, Roxb., the common banyan or *bargad*. On the other hand *kamela* itself is used to adulterate arnotto. The bark is employed in tanning. About 2,000 maunds of the powder are exported every year from the Kumaun forest division.

Punica Granatum, Linn.—Pomegranate—*Anár, dárim*, and the rind of the fruit *náspál*. The rind of the pomegranate is used as a tan and dye for leather and gives cloth the greenish colour known as *kakrezi*. It is, however, generally used with some other dye as a concentrator, in which case the pulverised rind is boiled along with the dye. The flowers also yield a fleeting dye of a light-red colour. Morocco leather is tanned and dyed with the bark of this tree, of which the export amounts to the large quantity of 270 tons per annum from the Kumaun forest division alone.

Terminalia Chebula, Retz.—*Har, harara*. The dried fruit are the black or Chebulic myrobalans of commerce used as a dye, tan, and medicine. Galls are also found on the leaves which in conjunction with alum yield a good permanent yellow dye. The average yearly export from the forests between the Jumna and Sárda amounts to about 50 tons, of which the Kumaun forest division yields 550 maunds or about 20 tons.

Terminalia belerica Roxb.—*Bahera*. The dried fruit of this species also forms one of the myrobalans of commerce used in dyeing cloth and leather and in tanning. Native ink is made from it and it is also used in medicine. The average annual export from the same tract as the preceding is about ten tons.

Phyllanthus Emblica, Linn.—*Aonla, amlika*. The fruit of this species furnishes the Emblic myrobalans of commerce used as a dye, a tan, and in medicine. The bark is also used in tanning. The fruit is pounded and boiled in water, and in combination with sulphate of iron yields the bluish-black colour *abunsi*, and alone is used as a hair-dye and ink-material. The annual export from the Kumaun forest division is about four tons.

Ægle Marmelos, Corr.—*Bel*. The rind of the fruit is occasionally used with myrobalans by calico-printers, and by itself yields a fleeting yellow dye. The annual export from the Himálayan forests is, however, very small.

(*c*.)—*Extracted from flowers.*

Nyctanthes Arbor-tristis, Linn.—*Har, harsinghár, pakúra, ladúri, kiyera*. The flowers yield a fine but fleeting buff or orange-brown dye. It is much used in combination with other dyes, and the flowers can be had in any quantity from the submontane forests at from 2-6 seers per rupee.

Butea frondosa, Roxb.—*Dhák, palás, chichra*. The flowers (*kúsu, tesu*) yield a fleeting yellow dye with alum, much used in the Holi festival. The tree occurs abundantly along the foot of the hills, and is very remarkable from the effect produced by its large orange-red flowers.

Cedrela Toona, Roxb.—*Tún, túni*. The flowers of this well-known tree also yield a yellow dye known as *basanti*, from the practice formerly in fashion to wear clothes dyed yellow at the spring festival (*basant*). A red dye is occasionally extracted from the seed.

Tagetes erecta, Linn.—*Genda*. The flowers of this plant, the common marigold, also yield a yellow dye which is, however, but little used except by the poor.

Woodfordia floribunda, Salis.—*Dhái, dhaura, tháwa, dhárla.* The red flowers of this large shrub are used in dyeing silk ; the average annual export for this purpose from the tract between the Jumna and the Sárda being about 27 tons, of which about 200 maunds come from the Kumaun forest division. The leaves and twigs also yield a yellow dye.

Parmelia kamtschadalis, Esch.—Rose lichen—*Charila, chalpúri, charchhabíla, chalchalíra*. This lichen is used in calico-printing to give a perfume to the cloth and a rose tinge. The average annual export from the tract between the Ganges and the Sárda is about 25 tons.

TANS.

(a.)—*Tanning agents derived from the bark.*

Acacia arabica, Linn.—*Babúl.* The bark of this tree is the most plentiful and effective of all those used for tanning purposes. The legumes and leaves also have similar properties in a less degree. Besides tanning a skin, the *babúl* bark dyes it a buff colour.

Cassia Fistula, Linn.—*Amaltás, kitola, itola, kitwáli, simhára, sím.* The bark of this tree yields a tan and dye and, like the preceding, the pods contain much tannin. The average annual export of the bark from the forests between the Rámganga and the Sárda amounts to about sixteen tons.

Shorea robusta, Gaertn.—*Sál.* The bark of this tree, so well known for its timber, contains tannin, though it is not much used as a tanning material.

Butea frondosa, Roxb.—*Dhák, palás.* The bark contains an excellent tanning agent much used where *babúl* is not procurable.

Myrica sapida, Wall.—*Káiphal.* The bark is used in medicine and as a tanning agent. The average annual export from the tract between the Jumna and the Sárda amounts to about seventy tons.

Bauhinia purpurea, Linn.—*Kachnár, khairwál, gúriál.* A common small tree, the bark of which is used in tanning.

Buchanania latifolia, Roxb.—*Kath-bhiláwa, muriya, piyál.* The bark of this tree is also a tanning agent.

Garuga pinnata, Roxb.—*Kharpat.* The bark yields a tanning material.

Zizyphus Jujuba, Lam.—*Ber, khalis, guler.* This tree yields a much valued tanning material in its bark. The export of oak bark of various kinds from the Kumaun forest division alone amounts on an average to between 50 and 60 tons per annum.

(b.)—*Tanning agents derived from fruits.*

Terminalia Chebula, Retz.—*Har, haraira.* This and the fruit of *T. belerica* form the Chebulic and Beleric myrobalans of commerce, used as an ingredient in tanning mixtures.

Semecarpus Anacardium Linn.—*Bhiláwa.* The fruit of this tree, better known as the 'Marking-nut tree,' is used in medicine and as an ingredient in varnish. When pounded and boiled in rape oil it is applied to stay putrefaction in hides.

The *babúl*, *dhao*, *bahera*, *har* and *dhauri* or *bákli* (*Anogeissus latifolia*, Roxb.) are also used as tanning agents, and the milky juice of the *ák* or *madár* in curing catgut and cleaning leather.

C.—GUMS AND GUM-RESINS.

There are six classes of gums known to commerce, each of which admits of numerous varieties: (1) gum-arabic; (2) gum-senegal; (3) cherry gum and the gum of other stone-fruit trees; (4) gum-tragacanth; (5) gum of Bassora, and (6) the gum of certain seeds and roots.[1] The first five spontaneously flow from trees and the sixth is extracted by boiling water. Representatives of (1), (3), (4), and (6) occur in Kumaun, and in addition we have the oleo-resin *bhiláwa* and tar and turpentine. The better classification, however, is that proposed by Cooke, *viz.*:—

I.—Gums—

- A.—True gums—
  - (*a*)—Arabic kind as *babúl* (*Acacia arabica*).
  - (*b*)—Cherry kind as *padam* (*Prunus Puddum*).
- B.—Pseudo-gums—
  - (*a*)—Tragacanth kind as *kulu* (*Sterculia urens*).
  - (*b*)—Dark or Moringa as *sahajna* (*Moringa pterygosperma*).
- C.—Astringent gums as dhák (*Butea frondosa*).

II.—Gum-resins—

- A.—Emulsive as *gota-ganba* or *gamboge*.
- B.—Fœtid as *hing* or asafœtida.
- C.—Fragrant—
  - (*a*)—Bdellium kind as *gúgal*.
  - (*b*)—Benzoin kind as *lubán*.

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[1] For a full account of the 'Gums and Gum-resins' in these Provinces, see my "Notes on the Economic Products of the N.-W. Provinces," Part I., Allahabad, 1876.

III.—Resins—

A.—Hard or Copaline—

(*a*)—Pale resins as *safed damar* (*Vateria indica*).

(*b*)—Dark resins as *kála damar*.

B.—Soft or elemi as *jangli-bádám* (*Canarium commune*).

IV.—Oleo-resins—

A.—Balsams as *bálsan-ki-tel*.

B.—Varnishes as *bhiláwa*.

C.—Turpentine and tar.

The average annual export of gums, some years ago, from the Garhwál forest division was about 265 maunds, and of *birja* or pine-resin about 30,500 pitchers of 2½lb. each. From the Dehra Dún the export of *semli* gum is about 786 maunds, and of *dhák* gum about 27 maunds, whilst about 200 maunds of gum are exported every year from the Kumaun forest division. Taking gums alone, the *average yearly outturn from the Himálayan forests of these* provinces is about 1,300 maunds. If encouragement were offered and trained collectors were employed, the quantity of produce of each kind of gum would be much more than at present; but so long as African gums can be sold in the London market at their present low rates, there is little hope that this branch of industry can be extended with profitable results.

I.—GUMS.

A.—TRUE GUMS.

Acacia arabica, Willd.—*Babúl.* This common tree yields the East Indian gum-arabic or gum gattic of commerce used in medicine and the arts. The bazar collections, however, contain the gum of allied species under the same name, *babúl-ki-gond.* The gum exudes spontaneously or is procured by incisions in the bark, when the sap runs out and hardens into small lumps varying in form and size. There are two kinds, the brown and white gum; the former is more esteemed in medicine and the latter in the arts. The gum exudes principally in March-April, and a good tree should yield about 2lb in the year. The bazar specimens occur in broken tears of a brownish red to brown, light-brown and white colour, rather brittle with a shining fracture and wholly soluble in water, forming a dark-coloured mucilage. With this gum is usually collected and sold the gum of the following allied species :—

A. Catechu, Willd.—*Khair.*
A. Farnesiana, Willd.—*Wiláyati babúl.*
A. lenticularis, Ham.—*Khain.*
Albizzia procera, Benth.—*Safed-siras, kharanji.*
A. Lebbek, Benth.—*Siras.*
A. odoratissima, Benth.—*Wiláyati siras.*

Ægle Marmelos, Corr.—*Bel.* This tree yields a good gum-arabic, occurring in tears like coarse brown sugar and of a similar colour.

Prunus Puddum, Roxb.—*Padam, páya, paya.* This and the other species of cherry yield a gum-arabic of the stone-fruit kind which, however, is not of commercial importance owing to the smallness of the yield and the presence of other gum-bearing trees.

Buchanania latifolia, Roxb.—*Piyál, muriya, kath-bhiláwa.* This tree occurs commonly in the Bhábar and yields a pellucid gum by incision, known in the plains as *chironji-ki-gond.*

Bauhinia variegata, Linn.—*Kachnár.* This and its allied species yield a gum known as *sem-ki-gond.* It is said to be a brownish mild gum that swells in water and is only partly soluble.

Careya arborea, Roxb.—*Kumbh.* This tree yields a greenish gum regarding which but little is known.

Cassia Fistula, Linn.—*Kitwáli, amaltás.* A red juice exudes from the bark and hardens into a gum called *kamarkas*, regarding which further information is desirable.

Cedrela Toona, Roxb.—*Tún.* This tree yields a resin rather than a gum.

Sponia orientalis, Planch., yields a gum of the cherry tree kind.

Anogeissus latifolia, Wall.—*Dháwa, dhaura, bákli.* It yields a fine white hard gum used chiefly by calico-printers.

Odina Wodier, Roxb.—*Jhingan, jíban, sindan.* The gum is obtained from incisions in the bark and when solidified appears much like glue. It is used for ink-making and in the finer parts of stucco work. There are two sorts exported from Kumaun ; the white (*kanne*) picked from the tree and sold at about ten seers for the rupee, and the black (*jingan-ki-gond*) gathered on the ground and sold at fifteen seers for the rupee.

Elæodendron glaucum, Hook.—*Bakra, shauriya, mámri.* The gum produced by this tree is known as the *jamrási* gum in the Central Provinces. It occurs in roundish tears and is soluble in water.

Feronia Elephantum, Corr.—*Kath-bel, kait.* The gum of this tree is recommended as a substitute for gum-arabic in medicinal preparations.

Woodfordia floribunda, Salisb.—*Dhái, dhaura.* The gum of this tree deserves further examination. It appears to be of the tragacanth kind and swells in water. Specimens of the gum from the following trees known to yield gum should be collected and subjected to examination:—

Scientific name.	Vernacular name.	Page in Brandis.	Scientific name.	Vernacular name.	Page in Brandis.
Citrus Aurantium ...	*Narangi* .	53	Semecarpus Anacardium,	*Bhiláwa*...	124
„ medica ...	*Bijaura* ..	51	Terminalia Arjuna ...	*Arjún* ...	224
Phyllanthus Emblica,	*Amlika* ...	454	„ tomentosa..	*Sain* ...	225
Erythrina indica ...	*Pangara* ...	139	„ belerica ...	*Bahera* ...	222
Garuga pinnata ...	*Khaipat* ...	62	„ Chebula ...	*Har* ...	223
Jatropha Curcas ...	*Safed-ind* .	442	Zizyphus oxyphylla ...	*Jigar* ...	85
Melia Azedarach ...	*Bakáyan* ...	68	„ Œnoplia ...	*Beri* ..	86
Morus indica ...	*Tút* ...	408	„ Jujuba ...	*Bor* ...	86
Punica Granatum ...	*Dárim* ...	241	„ rugosa ...	*Dhauri* ...	89
Sapindus detergens ...	*Rítha* ...	107	Schleichera trijuga ...	*Kusumbha,*	105

B.—Pseudo-Gums.

(a.)—*Pale or tragacanth kind.*

Cochlospermum Gossypium, D. C.—*Kúmbi.* This tree yields the gum *katíra* of the local Materia Medica. It occurs in semi-transparent, white, striated pieces very much twisted and contorted.

Sterculia urens, Roxb.—*Gulu, kuru.* This tree also yields a gum *katíra* that occurs in large light-brown transparent tough masses. Immersed in water like the other pseudo-gums it swells like a jelly, but does not dissolve except by protracted boiling. *S. villosa,* Roxb. (Brandis, 32), the *udála* or *udiyál* of Kumaun, and

S. colorata, Roxb. (Brandis, 34), the *bodula* of Kumaun, yield a similar gum.

(*b.*)—*Dark or Moringa kind.*

Moringa pterygosperma, Gaertn.—*Sahajna.* This tree yields a gum of the sort known as *mocharas*, used in medicine. It occurs in irregular pieces of a whitish to a reddish-brown colour.

Bombax malabaricum, D. C.—*Semal.* The gum of this tree is also known as *mocharas.* It occurs in opaque, light-brown, knotty pieces, inodorous and of a slightly astringent taste, and contains a large proportion of gallic and tannic acids. It is chiefly used as an astringent in medicine.

Stereospermum suaveolens, D C.—*Páral.* This tree yields a gum of the same character as the preceding, but not in general use nor sufficiently examined.

C.—ASTRINGENT GUMS.

Pterocarpus marsupium, Roxb.—*Bíja-sál.* This tree, rare in Kumaun, yields a gum of the kind known as *kino.* It is procured by incisions when the tree is in flower, and the gum is collected on leaves placed beneath the cuts in the bark. It forms a part of the commercial East Indian gum-kino.

Butea frondosa, Roxb.—*Dhák, palás.* The gum of this useful tree is the principal sort exported as gum-kino under the local name *kamarkas.* It occurs in the form of tears which when fresh are of a beautiful red colour, but when kept for any time become opaque and darker in colour. It is used in medicine and for tanning and dyeing.

Ougeinia dalbergioides, Benth.—*Sándan, chándan.* This tree yields by incision a sort of gum-kino used medicinally for the same purposes as Butea kino.

II.—GUM-RESINS.

A.—EMULSIVE GUM-RESINS.

Under this class come the products of trees of the genus *Garcinia*, none of which occur in these provinces.

B.—FŒTID GUM-RESINS.

Under this class we have asafœtida, gum-ammoniacum, and others that do not occur in these provinces.

C.—FRAGRANT GUM-RESINS.

To this class belong the gum-resins which are not emulsive and do not possess the fœtid odour of the preceding, but none of them occur in these provinces.

III.—TRUE RESINS.

A.—COPALINE RESINS.

Shorea robusta, *Gærtn.*—*Sál.* The *resin of the sál* constitutes one of the common dammars of the bazar and occurs in small rough pieces from a pale creamy colour to a dark-brown nearly opaque and very brittle. Each piece has a striated appearance, as if composed of several layers It is devoid of taste and smell, sparingly soluble in alcohol, almost entirely so in ether and perfectly so in turpentine and the fixed oils. The superior kinds are sufficient substitutes for pine-resins in medicine. Since the conservation of the *sál* forests has been taken in hand the export of this resin has very much declined.

B.—ELEMI OR SOFT-RESINS.

No representative of this group is traceable in Kumaun, though several occur in Southern India.

IV.—OLEO-RESINS.

A.—BALSAMS.

No representative of this group occurs in the North-Western Himálaya, though common in Eastern Bengal and Asám.

B.—NATURAL VARNISHES.

Semecarpus Anacardium, *Linn.*—*Bhiláwa.* The pericarp of the fruit is full of an acrid juice used in medicine and to form a black varnish. There is a considerable trade in these seeds, of which the exports from the forests between the Jumna and the Sárda every year amount to about 125 maunds. Varnishes are also said to be procured from the *Odina Wodier* noticed before for its gum, *Buchanania latifolia*, *Rhus succedanea*, and *R. vernicifera*, all of which occur in the Himálayan districts of these provinces.

C.—TURPENTINE AND TAR.

Pinus longifolia, Roxb.—*Chír, sulla, kolon, saral, thansa.*

The long-leaved pine is the principal source of the oleo-resin known as *birja* in Garhwál and *lisha* or *lassa* in Káli-Kumaun, and of the oil called *birja-ki-tel* or *tárpin-ki-tel*. There are two kinds of resin : (1) the *birja* or *berja* sort, which comprises the tears exuding naturally from the bark ; and (2) the *bakhar-birja*, or resin produced by making long and deep incisions in the sap-wood. The latter is chiefly used by bangle-makers. The resin is highly charged with oil of turpentine, and of late years some attempts at extracting it have been made. The oil of turpentine sells at from twelve to fourteen annas per bottle, and the residue known as *sundras*, the black colophony of commerce, is sold on the spot at about four rupees per maund. I am not aware of any attempt having been made to value this product, but of a similar article from British Burma Dr. Forbes Watson writes (1873) :—

Turpentine.

"The crude turpentine from British Burma has been very favourably reported upon. It is the produce of *Pinus Khasyana* and *Pinus Massoniana*, the market rate being about 4*d.* per lb. in Burma. The reports of the two firms to which the sample was submitted for valuation are :—'No. 5—We have submitted the crude turpentine to the trade, and have their report to the effect that it appears to be of very fair quality. We estimate the market value would be from £12 to £14 per ton. No. 6—We have carefully examined the sample of rough or crude turpentine and found the quality to be fine and equal to any ever imported from the United States, where the distillation for this market and that of the continent (Bordeaux excepted) is carried on. Crude has ceased to be an article of import ; there was not any since 1868, where twenty years ago it was a great trade. The nominal value of the sample before us would be 13*s.* 6*d.* per cwt. Manifestly, if the value in Burma of this turpentine is about 4*d.* per lb., or 37*s.* per cwt., and its value here is only from 12*s.* to 14*s.* per cwt., it would be far better to rely upon home consumption.'"

The average annual export of resin from the Garhwál forests during the five years 1869-73 amounted to about 35 tons. During the same period the average annual export of the *birja* sort from the Kumaun forests was 86 maunds, of the *bakhar-birja* description 45 maunds, and of the oil about 10 maunds. This industry is now discouraged as much as possible owing to the destruction of much valuable timber. The chips of the *chír*, *deodár*, and *P. excelsa*, yield tar by dry distillation. The following account of the process is given by Mr. Baden Powell:—"First an earthen *ghara* or vessel with a wide mouth, and capable of containing about four sers, is sunk in the ground. Next a large *ghara* of about twelve sers capacity is taken, and three small holes are drilled in its underside: it is then filled with scraps of the pine wood, and over its mouth another small jar is placed and kept there by a luting of clay very carefully applied, and then both the jars are smeared over with a coating of clay. These two jars thus stuck together are next set on the mouth of the receiver or *ghara* sunk into the ground, and the joint or seat is made tight by a luting of stiff clay. Light firewood is now heaped around the apparatus and ignited, and kept burning from four to eight hours; the rationale of the process being that the heat causes the tar contained in the chips inclosed in the large *ghara* to exude, and it falls through the three holes drilled in the bottom, and into the receiver sunk into the ground. When the fire is out, the ashes are raked away, the jars very carefully separated, so that pieces of dirt may not fall into the receiver, and the latter is then exhumed and the contents poured out. It is only necessary to replace the receiver with the jars over it as before, duly charged with chips, and lute the joints up carefully, and the process can be carried on as before. With care the same jars may be made to do over and over again without cracking. One ser of wood yields about 2·6 chhatáks of tar and 4·3 chhatáks of charcoal. To procure a ser of tar requires 6 sers 4 chhatáks of wood chips to charge the pot, and 2 maunds 6 sers and 9 chhatáks of chips for fuel. The estimated cost is one anna per ser, but this is far too low."

Tar.

Besides the long-leaved pine the following conifers[1] occur in the Himálayan districts of these provinces, and some yield resin, tar, and turpentine.

Pinus excelsa, Wallich. Brandis, 510. The tar produced from this tree is said to be equal to the best Swedish. It is a mixture of resin and oil of turpentine more or less blackened by the admixture of empyreumatic products. It thickens after exposure to the atmosphere and is used for protecting wood-work in every position.

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[1] For the intricate vernacular synonym see *postea*.

Pinus Gerardiana, Wallich. Brandis, 508. This tree is very resinous and is much used for torches. Major Longden obtained excellent tar from the chips. Gordon states that it affords abundance of fine turpentine and the cones exude copiously a fine white resin. Brandis says it is very resinous and that a good white resin may be obtained in quantity from the bark and cones.

Cedrus Deodara, Loudon. Brandis, 516. The *deodár* yields an oleo-resin like that of the *chír* and an oil which is used in medicine. Tar is also procured from the chips of the sap-wood.

Abies Smithiana, Forbes. Brandis, 525. Both Stewart and Royle mention it as a resin-bearing conifer. It does not appear to be common east of the Alaknanda.

Nothing is recorded regarding the resinous properties of *A. Webbiana* and *dumosa* and of *C. torulosa*. *Juniperus communis, recurva* and *excelsa* and *Taxus baccata* are the great sources of *dhúp* or incense in India and Tibet.

Elastic gum-resin.

Calotropis gigantea, R. Br.—*Madár, ák.* This and the allied species, *C. Hamiltonii,* Wight., yield an elastic gum-resin which is procured by making incisions in the plant and is used as a substitute for gutta-percha. Dr. Riddell calculated that ten average-sized plants will yield as much juice as will make one pound of this substance. The juice when collected is evaporated in a shallow dish, either in the sun or in the shade, and, when dry, the substance is worked up in hot water with a wooden kneader in order to get rid of the acridity of the gum. The juice is also used to destroy the offensive smell of fresh leather and in medicine. The *madár* also yields a kind of manna known as '*shukr-ul-ushr*,' which is caused by an exudation from the piercing of an insect called *galtiyál*.

LAC.

Lac is found all over these provinces, notably in the Bundelkhand, Bhábar, and Gorakhpur forests. It consists of a resinous substance produced from the female of the *Coccus Lacca*, an insect which is found on the twigs and branches of the pípal (*Ficus religiosa*), bargad (*Ficus indica*), kathbel (*Feronia Elephantum*), ber (*Zizyphus Jujuba*), dhák (*Butea frondosa*), the *Erythrina indica*, *Schleichera trijuga*, *Inga dulcis*, and others. The Hindús have six names for lac, but they generally call it *laksha* (*lakh*, 'one hundred thousand)' from the multitude of small insects which, as they believe, discharge it from their stomachs and at length destroy the tree on which they form their colonies.[1] There are two products from this resin, the lac dye and the various forms of the resinous lac. A description of the insect will be found hereafter in its proper place.[2]

Manufacture.

The process of manufacture may be briefly described as follows:—The stick-lac as it is brought in is picked and triturated in water, which takes out the colouring matter that forms the dye, and the residue deprived of all impurities forms the seed-lac. This is then sewed up in a long narrow bag about the size of a cable and passed over a charcoal furnace; when the resin melts and when quite fluid it is passed on to a man seated before another charcoal fire with a cylinder of glazed earthenware in front about two feet long and eight inches in diameter supported on pivots at each end : or in some places the stem of the plantain is used. The melted wax is allowed to drop on the cylinder and forms thin layers about eighteen inches square known as shell-lac. These are sorted according to consistence and colour ; orange, liver, garnet and their varieties being the order of excellence. Sometimes the seed-lac is merely melted into buttons or lumps, but this is usually only done with lac of inferior quality and for home consumption.

The analyses of Unverdorben and Hatchett give the constituents of stick-lac as—(1) an odorous resin soluble in alcohol and ether ; (2) a resin insoluble in ether ; (3) a bitter balsamic resin ; (4) laccic acid; (5) a dull yellow extract ; (6) colouring matter ; (7) a fatty matter ; (8) some salts and earth. The resin according to Unverdorben contains—(1) a resin soluble in ether and alcohol ; (2) a resin insoluble in ether and soluble in alcohol; (3) a resinous body little soluble in alcohol; (4) a crystallizable resin; (5) an uncrystallizable resin. Hatchett's analysis of 100 parts gives resin, 68; colouring matter, 10; wax, 6; gluten, 5·5; foreign substances, 6·5; loss, 4. His analysis of shell-lac gives resin, 90·5; colouring matter, 0·5; wax, 4·0; gluten, 2·8; loss, 1·8.

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[1] Sir W Jones quoted by Birdwood, 274, 322. Other insects of this genus furnish a colouring matter. The female of *C. ilicis* is the Kermes ; that of *C. Cacti*, the nopal or cochineal and the female of C. *polonicus* produces the scarlet grains of Poland.

[2] Chiefly from Carter's notice in Ann. Mag. Nat. Hist., VII., 31, 41.

The lac insect can be removed from one forest to another by merely taking the insect on the stick while in its transition state and applying it to the branches of a similar tree. There are two seasons of the insect's activity in Upper India, the one commencing in June and the other in November. The first crop is ready in September and the second in February or March, but neither are gathered until the season for the next operation has commenced. Thus the March crop may be gathered in June and the September crop in November. Should, however, the object be more to obtain lac dye than resin, the sticks should be gathered before the insect escapes to commence its next season's operations. The best Indian lac of these provinces is manufactured at Mirzapur, where the materials are collected from all parts of the North-west, but principally from the jungles of Central India as far south as Sambhalpur. Lac makes an excellent varnish and is used in combination with various colouring matters to make the durable lacquer so well known in Benares toys. It is also used for sealing-wax and for housepainters' varnish.

D.—FIBRES.[1]

The forests and wastes of the lower hills and the submontane tract yield an immense quantity of materials for ropes, cordage, twine, basket-making and matting, but little of which has as yet received the attention due to it. The *bábar* grass alone is sufficient in quantity to supply all India with a valuable material for making coarse cordage and paper. The bambu of the Garhwál Dúns might be utilised in the same way, and the reeds and grasses of the Bhábar and Tarái afford an inexhaustible supply of common twine and matting material. The hemp of Garhwál has more than a local reputation and for a long time furnished a portion of "the annual investment" of the East India Company. The pulp manufactured from the *Daphne papyracea* yields materials for a paper that gives the engraver finer impressions than any English-made paper and nearly as good as the fine Chinese paper that is employed for what are called India paper-proofs. The paper made from this shrub in Kumaun is almost as strong and durable as leather and is largely used for village records and court proceedings. It is exported to Tibet on the north and to the plains on the south for manuscripts and account-books. With this wealth of raw material in existence it is remarkable that so little has been done to render the fibre resources of our hills available to European enterprise, and it is the object of the following pages again briefly to bring them to notice.

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[1] A botanical description of all the fibre-producing plants mentioned in the following list will be found in Part VI. of my "Notes on the Economic Products of the North-Western Provinces." The reference at the foot of each notice here is also to a botanical description of the plant.

Abutilon indicum, Don. A mallow found in the lower hills and Bhábar, the stem of which yields a cordage fibre. Hooker, Fl. Ind., I., 326. *A. polyandrum*, Schlecht, found up to 3,000 feet, also yields a fibre. Hooker, *l. c.*, 325.

Hibiscus ficulneus, Linn., affords a very large proportion of strong fibre of a white colour useful for twine and light cordage. Hooker, *l. c.*, 340. *H. pungens*, Roxb., and *H. cancellatus*, Roxb. (Hooker, *l. c.*, 341, 342), also yield a soft, silky fibre useful for cordage, and are hence generically known in Kumaun under the name *kapasiya*.

Hibiscus cannabinus, Linn., *san*, grows wild and is also cultivated to a small extent in the Kota Dún and Bhábar. Hooker, *l. c.*, 339.

Kydia calycina, Roxb.; *patta, pattiya*; common in dry forests and along the submontane tract. Yields a strong coarse fibre from the inner part of the bark. Hooker, *l. c.*, 348.

Bombax malabaricum, D.C., cotton-tree; *semal*. The cotton from the pods is chiefly valuable as a half-stuff for paper. Experiment has shown that the staple is too short for use as a textile fabric (J. Agri-Hort. Ben., III., 122), and it is now chiefly employed for stuffing pillows and the like, and for this purpose there is a small export trade. Hooker, *l. c.*, 349.

Sterculia villosa, Roxb., is the *udála* and *udiyál* of the Kumaun Bhábar. This tree grows to a considerable size, but it is only the saplings from two to three years old that are useful for fibre. From these the layers of bark can be stripped off from one end to the other, the inner furnishing a fine and the outer a coarse cordage fibre that stands moisture well. One stem will yield about 2lb. of good fibre by steeping the bark well and beating it out with wooden mallets. The ropes made from it are strong enough for elephant harness, but are chiefly used for cattle halters. The rope is said to become stronger for a time from being frequently wetted, but it seldom lasts more than eighteen months if constantly exposed to moisture. The root of the tree is eaten in the hills. Hooker, *l. c.*, 355.

Sterculia colorata, Roxb, the *bodála* and *bodál* of Kumaun, occurs somewhat commonly at the foot of and along the lower range of hills. The bark yields a fibre for cordage similar to that of the preceding species. Brandis, 34.

Abroma augusta, Linn.: cultivated in gardens in the Dehra Dún where it is probably introduced. It yields a very strong fibre fit for cordage. Hooker, *l. c.*, 375.

Grewia asiatica, Linn.—*Pharsiya, phalsa, dhámin.* Occurs wild in the lower hills, cultivated in the plains. The inner bark yields a fibre like the basts of Europe. Hooker, *l. c.*, 386.

Grewia oppositifolia, Roxb., the *bhenwal* and *bhimal* of Garhwál and *bhengál* of Kumaun, occurs commonly in the lower hills 2,500-4,500 feet and up to 6,000 feet. It is occasionally cultivated. Hooker, *l. c.*, 384. It yields an inferior fibre similar to the preceding and for which the branches are cut from July until March or, indeed, at all seasons except in the spring. The leaves are given to cattle, and the sticks are soaked for a month or forty days in water and when dry are beaten on stones and the bark is stripped off. One tree will give about five sers of the inner fibre fit for making into ropes and twine, which are used for tying up cattle and for stringing cots. It is neither very strong nor very durable. Women use the green bark for cleaning their hair. (Hmd.)

Odina Wodier, Roxb.—*jinghan, Jíban, sindan*; occurs in the dry forests along the foot of the hills, ascending the outer range up to

4,000 feet. The bark yields a coarse cordage fibre. Hooker, II., 29.

Butea frondosa, Roxb.—*Dhák, palás;* is common in the Dúns and warm valleys and yields a very strong fibre from its bark used for caulking boats and making rope. Hooker, II., 164.

Desmodium tiliæfolium, Don.—*Chamara, matta;* occurs along the outer range 3-8,000 feet and yields from its bark a substance from which paper is made. In Kunaor there is some trade in this paper with Tibet. Hooker, II., 168: Panj. Prod., 516.

Bauhinia racemosa, Lam.—*Kachnál, gúrál;* occurs in the dry parts of the plains and ascends the hills in Kumaun to 5,000 feet. The inner bark yields a strong cordage fibre. Hooker, II., 276.

Bauhinia Vahlii, W. *et* A.—*Máljan, málu;* is a large creeper that occurs rather commonly in the lower hills and upper Bhábar from the Jumna to the Sárda, especially at the bottom of hot valleys and along the sides of precipices. The leaves are used for making umbrellas, and sewn together with twigs form baskets for holding pepper, turmeric, and ginger. They are also used as a substitute for plates at meals and by the petty shop-keepers to wrap up the goods that they sell. This creeper often attains a length of 40-50 feet, and is generally cut down in July-August, though it may be cut at all seasons. In its natural state it is used for making rope-bridges, but to manufacture rope from it, the outer bark is peeled off and thrown away and the inner coating is steeped in water and twisted when wet. A large creeper will produce a maund of this fibre known as *selu*. Before being used, the bark is boiled and beaten with wooden mallets, which renders it soft and pliable enough for being made into rope and twine used in the erection of rope-bridges, for thatching, stringing cots, and the like. These ropes though strong are not very durable and require occasional soaking, though if constantly kept in the water they rot quickly and altogether do not last more than eighteen months. The broad flat seed of the pod is eaten fried in clarified butter. Hooker, II., 279.

Gerbera lanuginosa is the well-known tinder-plant or *kapasiya* of Kumaun. The tinder is derived from the tomentum on the lower side of the leaves, which is also woven into twine and then netted into small bags for carrying hukkas, &c., so much in use amongst the hill-men.

Careya arborea, Roxb.—*Kúmbhi;* is a large tree that occurs in the forests along the foot of the Himálaya from the Jumna to the Sárda. The bark affords a fair fibre fit for cordage and twine. Hooker, II., 511.

Calotropis gigantea, R. Br.—*Safed-ák, madár;* is a large plant or shrub; common along the foot of the hills. This is the species that prevails in the Bhábar, where large patches of it occur, especially near Kálidhúngi, but it does not occur westwards of the Ganges at Hardwár. It yields a soft, silky fibre fit for cloth manufacture and for making the finer kinds of twine: see Sel. Rec. Bom., XVII.; Journ Agri-Hort. Ben., VIII., 73, 226, 231.

Calotropis procera, R. Br.—*Ak, madár;* is the prevailing species from Hardwár southwards and westwards. This species also yields a valuable fibre. Brandis, 331.

Marsdenia tenacissima, W. *et* A., occurs in the plains and ascends the hills up to 4,000 feet. The bark of the young shoots yield a fine fibre remarkable for its strength and toughness, formerly used by natives for bow-strings. Roxburgh, 258.

Marsdenia Roylei, Wight—*Murkúla;* a large knotty creeper that occurs along the outer ranges of the Himálaya up to 6,000 feet. It is cut at the knots and boiled in a mixture of ashes, after which the outside bark is thrown away, and the inner yields a fibre used for making fishing-nets and lines of great strength and durability and is capable of forming a cloth material. Brandis, 333.

Orthanthera viminea, Wight; the *chapkiya* of Kumaun; occurs along the foot of the Himálaya, ascending the lower valleys in Káli Kumaun for some distance. The bark is steeped in water and then yields a fibre that affords a good cordage material and is remarkable for its tenacity and length. Drury, F. P., II., 236.

Cordia Myxa, Linn.—*Bairala, baurala;* occurs wild in the forests below the Himálaya and is also cultivated in many parts of Upper India. The bark yields a fibre used for caulking boats and making rough cordage. Brandis, 336.

Daphne papyracea, Wall., the *set-barúwa* of Kumaun, *satpúra* of Garhwál, and *bhalu-suang* and *bholuwa* of Nepál. Two varieties of this species are commonly found in Kumaun :—the one with white flowers and yellow fruit occurs at 4,000-8,000 feet, and the other with purple flowers and fruit at 7-8,000 feet. Both yield a valuable paper-stuff from which the strong, tenacious hill-paper is made. The following account of the mode of manufacture is from a paper by Mr. B. H. Hodgson in J. A. S. Ben., I., 8 :—

Mode of making the hill-paper usually called Nepálese.

"For the manufacture of the Nepálese paper the following implements are necessary, but a very rude construction of them suffices for the end in view :—

1st.—A stone mortar, of shallow and wide cavity, or a large block of stone, slightly but smoothly excavated.

2nd.—A mallet or pestle of hard wood, such as oak, and in size proportioned to the mortar and to the quantity of boiled rind of the paper plant which it is desired to pound into pulp.

3rd.—A basket of close wicker work, to put the ashes in, and through which water will pass only drop by drop.

4th.—An earthen vessel or receiver, to receive the juice of the ashes after they have been watered.

5th.—A metallic open-mouthed pot, to boil the rind of the plant in. It may be of iron, or copper, or brass, indifferently ; an earthen one would hardly bear the requisite degree of fire.

6th.—A sieve, the reticulation of the bottom of which is wide and open, so as to let the pulp pass through it, save only the lumpy parts of it.

7th.—A frame, with stout wooden sides, so that it will float well in water, and with a bottom of cloth, only so porous that the meshes of it will stay all the pulp, even when diluted and diffused in water, but will let the water pass off when the frame is raised out of the cistern ; the operator must also have the command of a cistern of clear water, plenty of fire-wood, ashes of oak (though I fancy other ashes might answer as well), a fire-place, however rude, and lastly, *quantum sufficit* of slips of the inner bark of the paper tree, such as is peeled off the plant by the paper-makers, who commonly use the peelings when *fresh* from the plant ; but that is not indispensable. With these 'appliances and means to boot,' suppose you take four seers of ashes of oak, put them into the basket above-mentioned, place the earthen receiver or vessel beneath the basket, and then gradually pour five seers of clear water upon the ashes, and let the water drip slowly through the ashes and fall into the receiver. This juice of ashes must be strong, of a dark bark-like red colour, and in quantity about 2lb. ; and if the first filtering yield not such a produce, pass the juice through the ashes a second time. Next, pour this extract of ashes into the metal pot already described, and boil the extract ; and so soon as it begins to boil, throw into it as many slips or peelings of the inner bark of the paper plant as you can easily grasp, each slip being about a cubit long and an inch wide ; (in fact the quantity of the slips of bark should be to the quantity of juice of ashes, such that the former shall float freely in the latter, and that the juice shall not be absorbed and evaporated with less than half an hour's boiling). Boil the slips for about half an hour, at the expiration of which time the juice will be nearly absorbed and the slips quite soft. Then take the softened slips and put them into the stone mortar, and beat them with the oaken mallet till they are reduced to a homogeneous or uniform pulp, like so much dough. Take this pulp, put it into any wide-mouthed vessel, add a little pure water to it, and churn it with a wooden instrument like a chocolate mill for ten minutes, or until it loses all stringiness, and will spread itself out when shaken about under water. Next, take as much of this prepared pulp as will cover your paper frame (with a thicker or thinner coat according to the strength of the paper you need), toss it into such a sieve as I have described, and lay the sieve upon the paper frame, and let both sieve and frame float in the cistern : agitate them, and the pulp will spread itself over the sieve ; the grosser and knotty parts of the pulp will remain in the sieve, but all the rest of it will ooze through into the frame. Then put away the sieve, and taking the frame in your left hand, as it floats on the water, shake the water and pulp smartly with your right hand, and the pulp will readily diffuse itself in a uniform manner over the bottom of the frame. When it is thus properly diffused, raise the frame out of the water, easing off the water in such a manner that the uniformity of the pulp spread shall continue after the frame is clear of the water, *and the paper is made.* To dry it, the frame is set endwise, near a large fire ; and so soon as it is dry, the sheet is peeled off the bottom of the frame and folded up. When (which is seldom the case) it is deemed needful to smooth and polish the surface of the paper, the dry sheets are laid on wooden boards and rubbed, with the convex entire side of the conchshell ; or, in case of the sheets of paper being large, with the flat surface of a large rubber of hard smooth-grained wood ; no sort of size is ever needed or applied, to prevent the ink from running." See also As. Res., XIII., 385.

In Nepál this paper is manufactured exclusively by the tribes inhabiting cis-Himálayan Bhot, known as Múrmis, Lepchas, &c., or generically as Rongbo, in contradistinction to the Sokpo, the name given to the inhabitants of trans-Himálayan Bhot. The manufactories are mere sheds, established in the midst of the great forests of the upper ranges which afford an inexhaustible supply of the material as well as of wood ashes and good water, both of which are essential to the manufacture of the raw material into the blocks from which the paper is made. Specimens of these blocks sent to England have been pronounced by experts to be of unrivalled excellence as a material for the manufacture of that sort of paper upon which proof-engravings are taken off.

Wikstrœmia virgata, Meisner ; the *chamliya* of Kumaun ; is also common in the lower ranges from 5,000-7,000 feet. The paper made from its bark is considered inferior to that made from the bark of the preceding, as it allows the ink to run unless sized, but the bark also affords a strong cordage material, and ropes made from it are used in Naini Tál. Brandis, 386 : Drury, F. P., III., 86.

Bœhmeria nivea, H. *et* A. ; China-grass, Rheea ; grown experimentally in the Dehra Dún and at Sahéranpur. Yields the well-known rheea fibre which is specially noticed hereafter. Brandis, 402.

Bœhmeria macrophylla, Don.—*Gargela;* occurs common in the lower hills up to 4,000 feet. *B. platyphylla,* Don., is also very common and is known as *gargela ;* both yield a fine fibre fit for twine. Dr. Jameson notes that *B. lobata,* under the native name *ullah,* is found in Kumaun and also yields a fibre. Brandis, 403.

Girardinia heterophylla, Decaisne, the *awa-bichhu* of Kumaun and *bábar* of Simla, is a very common weed in the forests along the foot of the Himálaya and yields a fine, strong fibre much used for cordage and twine, but cannot stand much moisture. Brandis, 404.

Villebrunea frutescens, Blume, the *phúsar-patta*, *poi-dhaula* and *kágshi* of Kumaun, is commonly met with along the foot of the hills ascending to 5,000 feet. It occurs in the neighbourhood of Naini Tál and Bhím Tál and along the valley of the Sarju and Ganges. It has the appearance of a small bambu and grows 6-8 feet, varying in the thickness of the stem from the size of a quill to that of the thumb. It is cut down for use when the seed is formed. The bark or skin is then removed and dried in the sun for a few days; when quite dry it is boiled with wood-ashes for four or five hours and allowed to cool. When cold it is macerated with a mallet on a flat stone while cold water is applied and gradually the woody matter disappears, leaving a fine fibre which is admirably adapted for fishing lines and nets as well for its great strength as for its power of resisting moisture. Brandis, 406.

Maoutia Puya, Wedd.; the *púya* of Kumaun and Nepál, though sometimes known under the same vernacular names as *V. frutescens*, is common in the lower hills and Bhábar, ascending to 5,000 feet.

Debregeasia bicolor, Wedd.; the *tushiyára* of Kumaun; is very common all over the lower hills ascending as high as 7,000 feet and is particularly abundant in the Siwáliks. It yields a very strong cordage fibre. Brandis, 405.

Memorialis pentandra, Wedd.; the *jaiphal-jari* of Garhwál; is also somewhat common in the lower hills and yields a useful cordage fibre. Drury, F. P., III., 210. Swetenham notices a large nettle as occurring in Garhwál, from the bark of which a fibre is obtained after only three days' steeping by merely peeling off the rind from one end to the other. He considered it to be in every way far superior to the fibre of hemp. Huddleston mentions the *jarkand-álu*, *kand-álu* or *kalra* as yielding a fibre from which sandals and ropes are made in the north of Kumaun. It grows 8-9 feet and the stalks are about as thick as a man's finger. They are gathered in the cold season and, after being steeped in water for a few days, yield a fibre by peeling from the thick end in the manner of hemp. Both these notices probably refer to *G. heterophylla*, Decaisne.

Artocarpus integrifolia, Linn., (Jack-tree) and *A. Lakoocha*, Roxb., both yield a cordage fibre from their bark. The former is but rarely seen in the Kumaun division, and the bark of the latter is seldom used for this purpose.

Hemp.

Cannabis sativa, Linn.; *C. indica*, Rumph.; *gúr-bhanga* (female plant), *phúl-bhanga* (male plant). An annual 3-14 feet high according to soil and climate. Root white, fusiform, furnished with fibres. Stem erect, branched, green, angular, covered all over with an extremely fine but rough pubescence. The stem is hollow within or only filled with a soft pith, which is itself surrounded by a tender, brittle substance consisting chiefly of cellular texture with some woody fibres, which is called the 'reed,' 'boons,' and 'shove' of the hemp. Outside this we have the thin bark composed of fibres extending in a parallel direction all along the stalk. These fibres consist of delicate fibrils, united together by cellular tissue and all covered by a thin membrane or cuticle. Found abundantly in the *Himálayan districts* of the North-Western Provinces. The wild hemp known as *gandra-bhanga*, *ban-bhanga* or *jangli-bhanga*, is of little use for fibre.

The female plant yields seed for oil and the drugs *gánja* (see page 755), *charas*, &c. The male plant yields only fibre from which the *bhangela* cloth of Garhwál is manufactured; also called *kothla*, *bora*, and *gáji*, and the ropes (*sel*) for bridges. For the history of the plant see Royle (*Fib. Pl.*, 315) and Drury (*U. P.*, 106). The possibility of attaining success in the cultivation of hemp in these provinces was pointed out by Dr. Roxburgh as early as 1800, and on the cession of these provinces, skilled Europeans were sent to carry on experiments in the Murádabad and Gorakhpur districts. In Garhwál and Kumaun its cultivation was encouraged, and for many years the East India Company procured a portion of its 'annual investment from the *Kumaun hills in the shape of hemp*.' With the abolition of the Company's trade the cultivation languished and is now entirely dependent on the local demand, which, however, is by no means small.[1]

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[1] See 'Papers regarding the cultivation of hemp in India,' Agra, 1855: Royle's Fibrous Plants of India, London, 1855, and Drury's Useful Plants of India, Madras, 1858.

The following account of the cultivation is derived from Huddleston and Batten's notes. There are two varieties common in Garhwál, the wild and the cultivated. The former is practically useless either for fibre or the drug, so we shall confine our notice chiefly to the latter. The cultivated variety in Garhwál is grown chiefly on high lands having a northern exposure in well-prepared and abundantly manured soil close to the village site. Occasionally freshly cleared forest land gives a crop for one year without any need for artificial manure. Irrigation is never resorted to, nor is it needed if the soil be properly prepared. The plant does not flourish below 3,000 feet, as the heat of the valleys is prejudicial to its growth, and it seems to thrive best at elevations of 4-7,000 feet. The mountainous region occupied in Garhwál by the Badhán, Lohba, Chaundkot, Chandpur, Dhanpur and Dewalgarh parganahs, has the greatest area under hemp cultivation. These parganas are marked by lofty ranges, extensive forests and a fairly even temperature. The northern parganahs bordering on the snowy range have no hemp cultivation whatsoever, and there is very little in the parganas bordering on the plains, so that it may be said that the hemp-producing area in Garhwál lies between the Pindar on the north and the southern Nayár on the south and is bounded on the east by the western Rámganga and on the west by the Ganges. The cultivation of the plant as practised in this tract is as follows. The ground, after being well cleared and prepared for the seed, is sown, in the end of May or early in June, at the rate of 26 to 33 sers per *bísi*.[1] During the early growth of the plant the ground is kept free from weeds and the young plants are thinned, leaving a few inches between each, and until the crop has attained a good height, the ground is kept free from all rank vegetation, after which it attains a height of 12-14 feet and is cut in September-November. There are two classes of the cultivated plant, the female and the male. The latter is cut some 4-6 weeks earlier than the former and yields a much stronger and superior fibre. On the stalks being cut green, they are dried for several days in the sun by being piled against the walls of the terraced fields until they

Cultivation

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[1] The *bísi* is 40 square yards less than an acre, and the seed used for it is 20-25 *pathas*, or 52-66 lb. avoirdupois.

become quite brown. The *charas* is extracted by rubbing the hands over the tops of the plant when the seed is ripe and is best in the *female plant. The exudation collected is scraped off the* hands and made into rolls for sale. The leaves are also pounded for *gánja* and *sabzi.* When the stalks are sufficiently dry they are tied up into bundles and steeped for 15-16 days in tanks or running streams, being kept under water by stones laid upon them. When taken out, they are beaten with wooden mallets and then dried in the sun. The fibre is then peeled off from the thick end of the stalk to the top, and after being again beaten and freed from impurities is tied up into hanks for sale and manufacture of sack-cloth for wear and for bags. For wear, the people simply fold the cloth around the shoulders and fasten it in front with an iron skewer, in the manner the inhabitants of the upper parganahs wear their blankets. Hemp-cloth is still the chief clothing fabric of the poorer classes in Garhwál during the summer months.

In Kumaun, hemp is cultivated chiefly in Chaugarkha, especially in pattis Lakhanpur, Dárún, Rangor, and Sálam. There is also a considerable quantity grown in patti Baraun of the Gangoli parganahs, and in a few villages in pattis Assi-Chálisi, Uchyúr, Mahryúri, Gumdes, Dhyánirau, and Malla Chaukot. As in Garhwál there is much prejudice against growing the plant, and it is left almost *entirely to the Doms, the Rajpúts considering it degrading to them* to be styled "hemp-growers." So much is this the case that the phrase '*tera ghar bhang bono holo*'—'may hemp be sown in thy house'—is one of the most common abusive imprecations. Still there are some differences in the obloquy attached to hemp cultivation, for whilst the Khasiyas may, without loss of caste, grow hemp and manufacture rope therefrom for house consumption, they must abandon the manufacture of hempen sack-cloth to the Doms, of whom the Koli, Bora and Agari sections possess almost an exclusive monopoly of hemp-weaving. All tribes, however, can traffic in the seed and rope, and even in the *charas,* without prejudice to their social position.

In Kumaun the sowing takes place from the middle of May to the end of June. In warm situations the hemp is sown rather later, in order that the heat and damp of the rains may cease before the plant shall have time to run into useless stalk and excessive seed. During July-August the ground about the plants is hoed and fresh earth is heaped up about the roots. The female plant ripens from about the middle of October to the middle of November, and the male plant, that yields the more valuable fibre, somewhat earlier. In Kumaun, the situation of hemp-growing villages is rarely so high as in Garhwál, and a cold climate, though preferred to that found at elevations below 5,000 feet, is not considered absolutely necessary. The favourite situation for the cultivation of hemp in Kumaun is a cool, dry, upland ground with a good soil and with facilities for manuring. Sites near the homestead or close to cattle-sheds in the pasturing grounds of the upper ranges are consequently chosen for the abundance of manure. Hemp is supposed to exhaust the soil, and the wheat and barley, which are commonly sown in succession thereto, are said to be defective both in quality and quantity.

When Dr. Rutherford held his contract for the supply of hemp for the East India Company's investment, he seems to have managed his enterprise by making advances to the headmen of villages or the principal cultivators; and should the cultivation of hemp over again become a commercial speculation, this would seem to be the best method for obtaining success. The produce of a *bisi* has been estimated at about three seers (6lb.) of *charas*, four maunds (320lb.) of hemp fibre, and 30-35 seers (60-70lb.) of seed, yielding about five seers (10lb.) of oil. In 1841, the fibre was produced for four rupees per maund delivered at the cultivator's doors or five rupees delivered at Kotdwára or Chilkiya, and it would appear that now a price of from six to seven rupees per maund of 82lb. would ensure a constant supply. In 1840, the entire value of the hemp produce in Kumaun, including seed, fibre, and drug, was little more than Rs. 1,000, and Captain Huddleston estimated the total area under hemp in Garhwál during the same year as only 250 acres, yielding about forty tons of fibre per annum; but there is every reason to believe that the outturn has since considerably increased in quantity, and a rough estimate would point to 780 acres under hemp in Garhwál alone in 1880. The seed is collected to be used as a vegetable food, for which purpose, indeed, it is chiefly cultivated in the Sor and Síra parganahs, or to be pressed for the extraction of hemp-oil or to be dried and retained for seed. The *charas* or juicy essence is collected for exportation, being hardly, if at all, used in the hills. It now sells at from four to five rupees per seer, and is resold by the farmer of the drug monopoly at eight rupees per seer. The farm of *charas* in Kumaun alone during 1880-81 was sold for Rs. 3,357. The leaves, too, are dried and exported for use in the various preparations of bhang. The fibres, as already noticed, are made into ropes or sack-cloth. In Kumaun the sale of the untwisted fibres is more common than that of the twisted or manufactured stuff. In 1840, the seed sold at about three rupees per maund, and is now worth about three to four rupees per maund, and in some places where it is chiefly used for culinary purposes is even cheaper. The fibre where it was produced sold at from two to three rupees per maund in 1840 and is now worth from three and a half to four rupees a maund. The *bhangela* or hemp-cloth is made up into sheets for weaving or into *kotlas* or sacks, and the finer sorts into *thailis* or bags for carrying flour and lime. A large sack-cloth bag cost but six annas at Almora in 1840 and is now worth twelve annas. Bags of a smaller size cost about two rupees per dozen in 1840 and are now proportionately more expensive. The produce is so small and the demand for bags for sending potatoes to the plains so great that these sacks are yearly advancing in price, and a considerable trade in them exists at Rámnagar and Kotdwára.

Prospects of the hemp industry.

Mr. J. H. Batten, in one of his reports, gives the following opinion on the prospects of hemp cultivation in Kumaun :—"If a large demand for hemp, the produce of these mountains, were to arise and it were to become generally known that capital to a considerable amount was ready to be expended for the purpose of procuring the article, a very great increase of hemp cultivation might be expected even in Kumaun Proper, but especially from the Chaugarkha parganah. If European capital should hereafter be employed in increasing the growth of the excellent hemp existing in this province, I should certainly recommend that the means first used for the purpose should be an outlay of money in advances to and purchases from the present growers and manufacturers, rather than in the attempt on the part of any enterprising individuals to procure land and grow hemp for themselves. Notwithstanding their prejudices, I think that the example of their neighbours, if the latter attained to any fair degree of prosperity from the increase of trade, would soon be followed by many villagers throughout Kumaun, who now are indifferent to or despise their advantageous situation for the growth of hemp, and large tracts of land now waste would be brought under cultivation. There are not in Kumaun, as in Garhwál, many waste villages still left unowned and unclaimed; and from what I have seen of the character of the people in Kumaun Proper, I think that any stranger who should purchase or rent land within the boundary of a village, for the purpose above indicated, would be quite as liable to litigation, inconvenience with his neighbours, and prejudices against his position, as in any part of India, however populous in comparison. In the case of advances and purchases on the contrary, the transactions of capitalists would be confined to simple contracts, of a nature to which, if found necessary, the law is open at a cheaper cost, and under simpler forms, than in most other parts of the country." Captain (now Sir Henry) Ramsay, in a report on the same subject, writes :—"I would not advocate the system of making advances to individual cultivators: it is not improbable that some ill-disposed persons might create a suspicion that Government intended evil instead of good and actually produce the effect of making those who now grow hemp discontinue its cultivation for a time; the best plan I think would be to enter into engagements with respectable zamindárs for large quantities and allow these contractors to make their own arrangements. The cultivators are quite equal to taking care of themselves in such dealings."

Cultivation in Nepál.

Hemp is also grown in the northern parganahs of Nepál, and the mode of cultivation there is thus described by Mr. B. H. Hodgson:—"The seed is sown from March to April. Damp soils, comprising black earth, are fitted for this crop. Before ploughing the field, sufficient manure is to be sprinkled over it, then completing the work of the plough, the seeds are to be sprinkled, and having broken the clods into dust, the field is to be made even. At seven or eight days after sowing the seeds the plants come up, but their rapidity of growth and their size and strength depend on the abundance of the rains or artificial watering. If the plants be very thick, they must be thinned, so as to stand three inches distance from each other. They flower and fruit in Sáwan (July), and at the beginning of Bhádon (August) are in their full growth; but while yet succulent and in flower they are to be cut, with the exception of some seed plants, which are not to be gathered until October. It is the bark of the young but full-grown or Sáwan plants (which is soft) that is used for making *bhangela*. That of the old or October plants is hard and not suitable for manufacture. After the plants have been cut off at the ground, they must be placed in the sun for eight or ten days, or until they be dried sufficiently. They must then be steeped in water for three days, and on the fourth day the plants must be taken out of the water and peeled. The peelings are to be washed and put in the sun; and when quite dried, they are ready for manipulation. They are then to be torn into thin threads with the nails of the hands; next twisted with a spinning-wheel (*tikuli*), and when the threads are thus prepared, they are to be boiled with ashes of wood and water in a pot for four hours, and to be washed again for the purpose of whitening. This is the way of preparing *bhangela* thread, out of which sack-cloth is woven. One *mána* (half a *kachcha ser*) of seed is sufficient for a *ropini* of land (one-fifth of a *bádshdhi bigha* or 605 square yards), which produces ten or twelve loads of *bhang*. Hemp grows equally well on slopes and flats, and near the tops as well as on the sides of the mountains, if not too low. But a moist rich soil is indispensable. The plant attains to a height of eight to ten feet, and should be cut when the flower is falling and the seed forming." For an account of its cultivation in other countries, see Royle (*Fib. Pl.*, 338).

Hemp prepared for the European market should have the fibres laid parallel to each other and then be simply tied near the thicker end, so as to form heads like the Petersburgh hemp, not twisted, plaited and tied, as is the custom in our hills. The Himálayan hemps show strength, divisibility, fineness and softness of fibre—in fact all the essentially good qualities which a fibre should possess.

Chamærops Martiana, Wall., the *jhangra, jager*, and *thákil* of Kumaun, occurs on Bhatkot, Thákil, Dhuj, and in the valley of the

Sarju. The fibre is used for cordage and the leaves for mats and baskets. Brandis, 546.

Calamus Rotang, Linn.—Rattan—*bet;* occurs abundantly in the Eastern Dún, in places in the Siwálik tract and along the outer hills eastwards. It yields the common rattan so much used in upholstery and for basket work. Brandis does not consider *C. Royleanus*, Griffith, as distinct. This species has also its western limit in the Dehra Dún and is known under the same vernacular name and used for the same purposes. About fifty bullock-loads are exported every year from the Kumaun forest division. Brandis, 559.

Typha angustifolia, Linn.; Var. *elephantina*, Roxb.—*Bora.* This species occurs throughout the North-Western Provinces and Oudh, ascending the hills in the Káli valley, and indeed in most of the valleys bordering on the plains. It is the *reri* of the upper districts, and the variety *elephantina* is the *puleri* or *pateri* of the hills. The leaves are much used in the manufacture of soft matting, and from Kumaun alone about twenty bullock-loads of the raw material and 3,500 pieces of the matting are exported every year. *T. latifolia*, Linn., is called *patera* in Bijnor and *kanda-tela* in Garhwál, and the leaves are largely employed in the manufacture of a coarse matting called *boriya*, of which some 900 maunds are annually exported from Kumaun. In fact these two species afford the chief matting materials in common use. I am not aware that the leaves have ever been used for other purposes. Roxburgh, 648: Drury, F. P., III., 495:

Arundo Karka, Roxb., the *karka* and *nal* of the Kumaun Bhábar, is of common occurrence in suitable localities. *A.* (*Phragmites*) *Roxburghii*, Kunth., is the *bichhra* of Garhwál and the *khailu* and *khailuwa* of the Kumaun Bhábar, ascending up to 3,500 feet in the valleys. *A. nepalensis* is the *nal*, *nal-tura*, and *tot-nal*, common in the Bhábar and found at Bhím Tál. All these are sent to the plains under the generic name '*nal*' and are applied to cane-work in chairs, matting and similar uses, and the fibre of the flower-stalks is manufactured into rope. About 220 bullock-loads are yearly exported from the Kumaun forest division. Roxburgh, 117.

Saccharum Munja, Roxb.—*Múnja.* The upper half of the culm is known as *sirki-múnja* or *sirki;* the lower half as *sentha* or *sarpat;*

the blade twisted and beaten yields the strong cordage known as *múnj*; the tufty leaves are called *sarkara* towards Hardwár. *Múnj* abounds along the banks of rivers and in sandy places and generally along the base of the hills from the Jumna to the Sárda and up the valleys to 3,500 feet. The fibre is made from the sheathing leaves of the culm and forms the material from which the *janeo* or sacrificial thread of the Hindus is made. *Múnj* is commonly employed as a tow-rope from possessing great elasticity and strength, with a power of resisting moisture common to few other fibres. It is also used for the rigging of boats, the bottoms of cots, chairs, and footstools, matting, in the manufacture of coarse paper, and as a string for fastening the bambu framework for the roofs of houses, and indeed for all common purposes in every district. The *sirki* is used for thatching, a covering or pawlin for carts, and for chairs and the like. Under the names *bhut* and *múnj* a considerable amount of the various products of this grass are sent to the plains. The returns for four years from Kumaun give an average export of 1,600 bullock-loads of the unmanufactured article and about 75 maunds of the rope. Drury, F. P., III., 653.

Saccharum spontaneum, Linn., is the *kásh, jasha* or *jhánsh* of Kumaun, according to Madden. It occurs commonly in the Bhábar and lower hills and is found near Almora, where its long-rooting *sarouli* are substituted for the *kusha* grass in religious ceremonies by the local Brahmans. The leaves yield a thatching grass and matting material and a fibre useful for string for common purposes. Roxburgh, 79. *Eragrostis cynosuroides* under the names *dábh* and *kusa* is used in the religious ceremonies of the Hindus.

Saccharum fuscum, Roxb., is a common reed of the Bhábar, where it is known as *tát, neja* (grass), and *mora*; it is the *kilk* of the plains. The culms are used in the manufacture of screens and pens. The average annual export of this reed from Kumaun amounts to over 800 bullock-loads. Drury, F. P., III., 653: Roxburgh, 79.

Saccharum Sara, Roxb., is the *sarkar* or *sarár* of the submontane tract, where it is very common. This reed is also used as a matting material and for chairs and the like, but the fibre is inferior to that of *S. Munja*, with which it is often confounded.

It is said, however, to be employed as a tow-line in Mirzapur, and must therefore possess tenacity and strength. Roxburgh, 82.

Eriophorum comosum, Wall., *Scirpus comosus*, Roxb.; *bábar*, *bab*, *bábila*, and at Almora *pan-babiyo*, only found in the Siwáliks and in low hot localities in the interior on bare and steep slopes. It forms but a small portion of the fibre exported to the plains as *bábar* or *bhábar* grass. The *jhúla* or rope bridges erected where *sangas* or planked bridges cannot be made are chiefly formed of this fibre in Kumaun. They are safe for men and sheep and last about a year, when the ropes require renewal. The *chhinkas* or bridges of a single cable bearing a transverse seat are sometimes made from it, and it is also extensively used in rafting timber. The principal portion of the *bábar* grass of commerce is derived from the *Spodiopogon angustifolius*, Trin. Drury, F. P., III., 530.

Cyperus tegetum, Roxb.; *Papyrus pangorei*, Nees; *motha*; grows wild and is also cultivated on the edges of inundated fields for the sake of its culms, which form an excellent material for matting. The culms whilst green are split into three or four pieces, which, in drying, contract so much as to bring the margins into contact, in which state they are woven into mats and thus show nearly a similar surface on both sides. *C. rotundus*, Linn., also known as *motha*, is applied to similar uses in a lesser degree. Roxburgh, 68, 70.

Imperata arundinacea, Cyrill., is the *shiro* of the Bhábar and lower hills, ascending to 7,500 feet. The culms are used for the same purpose as those of *múnj*, and the leaves for thatching and matting. Drury, F. P., III., 652.

Anthistiria arundinacea, Roxb., is the *ulu*, *ullah*, *kangúr* and *kandúra* of the Bhábar and affords the same products as the preceding. Drury, *l. c.*, 650.

Anatherium muricatum, Beauv., is the *gandar* of the submontane tract. The roots are commonly known as *kas* or *khas* and the culms as *sink*. The latter are exported from Kumaun with the *sirki* of the *múnj* under the same name and are used for the same purposes. The roots are exported for making tatties, dyers' brushes, and fans. Drury, *l. c.*, 644.

Spodiopogon angustifolius Trin.; *Andropogon involutus*, Steud.; the *bábar* of the tract from the Jumna to the Sárda. Dr. J. L. Stewart writes :—"This grass, which is abundant in the Garhwál Himálaya and occasional on the skirts of the Siwáliks, appears to furnish almost all the material called *bábar* so largely used for string in these parts (Bijnor). Botanists from Wallich and Royle downwards have stated this to be the produce of *Eriophorum comosum*, of which, however, only a very small proportion of that brought to the plains consists. Dr. Brandis first drew my attention to the probability of the ordinary belief being erroneous, and subsequent inquiry has shown the case to be as above stated. The string is very coarse but strong, and, although there is great waste in the manufacture, exceedingly cheap. It is well adapted for boat-ropes, the rope-work of bedsteads and other ordinary purposes. Possibly the *bábar* may come into play as a paper material; at least it is worth the trial, and probably larger quantities of the raw article could be got than of any other fibre in this part of the Himálaya." (J. Agri.-Hort. Cal., XIII., 293). The raw material is procurable for about eight annas per maund and the fibre at four times that price. About 25,000 bullock-loads are yearly exported from the Kumaun forest division.

Cymbopogon laniger, Desf.; *Andropogon Iwarancusa*, Roxb.; is known variously as *miriya*, *bán*, *ganguli*, *dáb*, and *píriya* in the submontane tract. It ascends the hills up to 5,000 feet at Almora and is found along the Sarju as far as Bágeswar; flowering in April. The culms are exported with those of the *mora* for similar purposes, and the leaves are used for thatching and coarse matting. The culms and leaves of *C. Martini*, Munro, are applied to similar uses. Roxburgh, 92.

Bambus.—The genera included under the common name bambus are sufficiently numerous and important to deserve special notice here in connection with their use as a half-stuff for paper-making. Following the arrangement of Brandis, we shall briefly refer to each in the order given by him in his 'Forest Flora':—

1. *Arundinaria falcata*, Nees—*Ningál*. Madden notes that the people of the Dánpur pargana in Kumaun enumerate no less than eight kinds of *ningála* or *ringál* as it is pronounced in Garhwál,

viz.,—*tham*, *utham*, *kutino*, *malingo*, *jhúmro* or *jhúngra*, *deo-ningála*, *gorningála*, and *dom-ningála*. The last is probably the common or *káli-ningála* found abundantly along the Gágar range, and, like the *jhúmro*, in much request for pens. Dr. Falconer referred it to the genus *Thamnocalamus*. The *tham* is said to be the largest of the whole and is sent down to the plains for hukka pipes. The *deo-ningála* is the *A. utilissima* of Edgeworth, and occurs in great abundance in the snowy range, especially in the upper valley of the Pindar. It affords excellent material for matting, baskets, fishing-rods and the like. The *gor-ningála* is the *gol* of Bisahr, with their culms eighteen feet high, occurring in dense clumps of a hundred or more each. Brandis (p. 562) gives to *A. falcata* a range of 4,500-10,000 feet, ascending to 12,000 feet from the Ravi to Nepál, abundant in places, gregarious, often forming underwood in moist forests of *Abies Smithiana*, *A. Webbiana*, and *Quercus semecarpifolia*. It flowers in May and the seeds ripen in August.

2. *Thamnocalamus spathiflorus*, Munro—*Ringál.*

This is probably the *káli-ningála* of the preceding notice, occurring in Rámpur. It is recorded from Deoban in Jaunsár, Dúdatoli in Garhwál, and Kumaun at elevations 8,000-11,000 feet. *T. Falconeri*, Hook. *f.*, is also recorded from the Madhari pass in Kumaun. See Brandis, p. 563.

3. *Dendrocalamus strictus*, Nees.—*Báns.*

To this species belongs the great mass of the bambus exported as minor forest produce from the Jumna to the Sárda. For the Garhwál forests, Dr. J. L. Stewart gives the following classification of cut bambus, beginning with the least valuable :—

1. *Chhanejú*, (*chhanejú*, K.), long and thin, used for roofing purposes.

2. *Láthi or láthichár* (*láthi-báha*, K.), thicker, shorter, solid, for walking-sticks and clubs.

3 *Bálu*, similar, but thicker, for sides of cots.

4. *Kanerva* (*kanderu*, K.), between the last two in thickness, but chiefly used for roofing purposes.

5. *Saráicha* (*saráinchu*, K.), much thicker, shorter, hollow; also used for roofing purposes.

6. *Dashutta*, similar, but much longer.

7. *Bhengi* (*bahaga*, K.), thickest of all and less hollow, used for tent and dooly poles. See further Brandis, p. 569.

Bambus form the most important portion of the minor forest produce of all the forest divisions and one that increases in value every year, but it is to the materials for half-stuff in paper-making which they afford that we wish to invite attention here, and for this purpose will refer to a paper[1] by Mr. J. Routledge on the subject. In his opening paragraph, he writes:—"Of all the fibre-yielding plants known to botanical science there is not one so well calculated to meet the pressing requirements of the paper-trade as 'bambu,' both as regards facility and economy of production as well as the quality of the 'paper-stock' which can be manufactured therefrom. Grown under favourable conditions of climate and soil there is no plant which will give so heavy a crop of available fibre to the acre and no plant that requires so little care for its cultivation and continuous production." Attempts have been made in England to obtain from the bambu a half-stuff or pulp for paper manufacture, but these have failed chiefly from using the plant when it had attained to some degree of maturity and the fibre had become extremely dense and the external skin hard and silicious. In this state the processes for softening the material and converting it into pulp by long-continued boiling or digesting in very strong solutions of caustic alkali at a high temperature were troublesome, expensive, and dangerous. Mr. Routledge would therefore take the young plant, and by a system of close plantations well watered and systematically cropped ensure successive growths available for preparation into stock. His estimate is as follows:—"Allowing 208 feet square to represent one acre divided into twelve beds each 96 × 26 feet with twelve paths 96′ × 8′8″ wide and one intersecting road 208′ × 16′ wide, leaves a space for planting equal to 2,496 feet, or 29,952 feet in the twelve beds; allowing the stems to be 2 feet apart and (say) only 12 feet high, we have 7,488 stems, which at 12lb each will yield 40 tons to the acre." Assuming that these 40 tons of green stems will lose 75 per cent. of moisture in drying, we have 10 tons of dry stems to the acre, which will yield 60 per cent., or six tons of unbleached fibrous paper-stock baled up in merchantable condition. It is unnecessary to enter into Mr. Routledge's system of treating the bambu for the manufacture of paper-stock, our object being merely to show that a practical paper-maker considers it possible to turn the preparation of bambu fibre into a profitable commercial speculation. Nothing has yet been attempted in this direction in India.

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[1] Bamboo considered as a paper-making material, by T. Routledge: London, 1875.

WOODS.

Timber trees.

The timber-producing trees of the Himálaya of these provinces are sufficiently described in the admirable work of Dr. Brandis on the *Forest Flora of North-West and Central India*, to which the reader must be referred for descriptions of those trees noticed hereafter and of those which do not claim a reference in a work like the present one. The forests themselves will be enumerated in the succeeding chapter, and here we shall only refer generally to their more valuable timber-products. The forests below the hills and those clothing the outer spurs contain *sál*, *sisu*, *tún*, and trees belonging to the genera *Acacia Terminalia*, *Anogeissus*, *Adina*, and *Stephegyne*, besides the grasses popularly known as bambus, all of which are of the first importance for house-building, furniture, agricultural implements and boat-building. From them is derived the greater portion of the revenue in the State forests, and omitting them, there would be little of any practical value to record. In the upper hills, the conifers clothe almost every ridge and valley within the zone of arboreous vegetation, and with oaks and rhododendrons, the box, maple and birch afford, if proper precautions be observed, an inexhaustible supply of every class of wood equal in quality to that procurable in Europe. The *sál* of the submontane tract and the cedar of the hills are held in the highest esteem and have been much worked in all easily accessible forests, but there are other trees that afford a timber equally suitable for most of the purposes to which the former are now applied. The *bákli*, *sain*, *haldu*, and *gosam* of the submontane tract and some of the oaks, the pine, spruce and fir of the hills give very valuable timber fit for everything except perhaps railway-sleepers, and it will be necessary, should the existing demand continue, to call on the reserve of these trees to supply all common wants. This can best be done by raising the duty on the more valuable timber, and the sooner a movement of this sort is made, the better it will be for the future of the *sál* and *deodár* forests, which now require rest and care. *Bambus* have already been sufficiently described on a previous page (p. 809), and it will not be necessary to notice them further here. We shall, therefore, restrict ourselves to a brief description of the most important trees in the forests of the submontane tract and of the conifers, oaks, and a few other timber trees in the hills. All of these have an ascertained value and are the chief sources of the timber supply for the plains.

Shorea robusta, Gaertn.—*Sál, kandár, sákhu* (plains). Brandis, 26 : Hook., I., 306. The *sál* occurs along the foot of the hills from the Jumna to the Sárda and also in the Dúns. It ascends the hills in places to 3,000 feet and is found in the valleys to a great distance inland, notably along the Sarju and Rámganga. It is the most valuable and most sought after of all the timber trees of the submontane forests and from time immemorial has been exported to the plains. It is usually the characteristic tree of the tracts which it affects, and though other trees occur, the *sál* predominates. In the Pátli Dún and other places where pure *sál* forests exist and thrive, the soil is usually composed of alluvial deposits, and drift in the valleys and plateaus and sandstone or conglomerate interspersed with blue shale on the ridges. Brandis notes that the climatic conditions favourable to its growth are a rainfall of 40-100 inches and a mean temperature during the four seasons within the following limits :— cold-season, 50-70°: hot season 77-85° : rainy season, 80-88°: autumn, 74-77°. The *sál* grows, as a rule, to a height of 60 to 90 feet with clear stems 30-40 feet long and 6-8 feet in girth. Further east under Nepál it attains much larger proportions and measurements are recorded of trees 100-150 feet in height and 20-25 in feet girth. Captain Wood has estimated the growth to be on an average (in the Oudh forests) 54 feet in 65 years and 72 feet in 95 years. The wood is reddish coloured, coarse-grained, even-fibred, hard, strong, tough, and so heavy that it cannot be transported by water without the aid of floats. The average weight of a cubic foot is 50-60lb.—with variations 40-69lb.—and its specific gravity is over 1,000. The transverse strength as ascertained from numerous experiments varies from 609 to 972. Baker found that a six-feet bar, two inches square, broke at 1238lb., and Brandis also records a number of experiments.

Cedrela Toona, Roxb.—*Tún, túni.* Brandis, 72. The *tún* is not now very common west of the Rámganga except in the low moist valleys leading into the Pátli Dún and in parts of the eastern Dehra Dún, and even to the east of that river the reserves have been denuded of most of the mature trees. The *tún* attains a height of 60-70 feet, with a girth of 6-10 feet. The heartwood is close-grained, hard, capable of taking a high polish like mahogany, and when properly seasoned is deservedly known as an excellent furniture wood. A cubic foot weighs 29-36lb, and the co-efficient of transverse strength ranges from 420-560. In one of Baker's experiments, a six-feet bar, two inches square, broke at 800lb. Stewart notes the interesting fact that in the small family to which the *tún* belongs there are four other valuable timber-trees, only one of which, the mahogany (*Swietenia Mahogani*), is extra-Indian. The others are Satin-wood (*Chloroxylon Swietenia*, D. C.) ; rohuna (*Swietenia febrifuga*, Roxb.), and Chittagong wood (*Chickrassia tabularis*, A. Juss.), all of which are indigenous in Southern India and the last also in Eastern Bengal. The *tún* ranks as a first-class timber in the forest tariff. The wood of *C. serrata*, Royle (Brandis, 73) the *dala* of Kumaun and 'bastard-toon' of Europeans, is of a lighter colour than that of the true *tún* and is used in the hills for house-building and the like.

Schleichera trijuga, Willd.—*Gosam, gausam, kosam.* Brandis, 105. This tree occurs in the Siwálik tracts and Dúns, ascending the valleys to 3,000 feet. It attains a height of 60-70 feet and a girth of 5-6 feet. The wood is reddish brown, close-grained, tough, hard and heavy, and weighs 66-70lb. to the cubic foot. It is much used for the crushers (*cháran*) for oil and sugarcane mills, pestles, rollers, agricultural implements and carts, and all work in which toughness and strength are desirable.

Dalbergia Sissoo, Roxb.—*Shísham, sissu.* Brandis, 149: Hooker, II., 231. The *sisu* occurs throughout the submontane tract and Dúns in moist places on the banks of streams and on islands in the rivers. It attains a height of 40-60 feet, with a girth of 6, and in very rare cases up to 12 feet. The sap-wood is light coloured and the heart-wood is of a deep brown colour, close-grained, hard and capable of taking a high polish. A cubic foot of seasoned wood weighs 45-50lb., of unseasoned wood 64-70lb. The co-efficient of transverse strength ranges from 700 to 900, being superior to nearly all other woods. A six-feet bar, two inches square, broke at 1,104lb. in one of Baker's experiments. *Sisu* is useful for all work requiring strength and elasticity, and is much employed for furniture, house-building, boat-building, carts, beds, saddle-frames, and agricultural implements. It is considered a first-class wood in the forest tariff.

Ougeinia dalbergioides, Benth.; *Dalbergia Oogeinensis*, Roxb. —*Sándan, sánan, chándan.* Brandis, 116: Hooker, II., 161. It occurs chiefly in the valleys of the outer hills, ascending to 5,000 feet and attains a height of 40-50 feet with a girth of 3-5 feet and occasionally 7-8 feet. The wood is close-grained, hard, strong, tough, and very durable. A cubic foot weighs 57-60lb., and it is much valued for wheels, ploughs, furniture and indoor household work. It is one of the first-class timbers in the forest tariff.

Acacia Catechu, Willd.; *Mimosa Catechu*, Linn., *M. Sundra*, Roxb.—*Khair.* Brandis, 186. The *khair* occurs along the submontane *tract and in the Dúns, ascending the valleys to 3,000 feet.* It has been much worked for the extraction of *kath*, and in the more accessible tracts few large trees remain. It attains a height of 30-40 feet, with a girth of 4-6 feet and occasionally 8-10 feet. The heart-wood is of a deep red colour, close-grained, hard, tough, elastic and heavy. It is admirably suited for crushers (*chúran*) for oil and sugarcane mills, and for this purpose yields only to the tamarind. It is also largely used for axles, pestles, pins, plough-shares, cotton-rollers, wheels, bows, spear-handles and the like, and is one of the most valuable of the second-class woods. Its product, *kath*, has been noticed elsewhere (p. 775).

Terminalia tomentosa, W. *et* A.; *T. crenulata* and *coriacea*, W. *et* A.; *Pentaptera crenulata*, *coriacea*, and *tomentosa*, Roxb.—*Sain, ásin, asain, sáj.* Brandis, 225. This tree is common in the submontane tract and the Dúns, attaining a height of 80-100 feet, with a girth of 8-10 feet. The heart-wood is dark-brown, tough, strong, elastic, and very durable. A cubic foot of seasoned wood weighs 60lb, varying from 50-70lb. The co-efficient of transverse strength is 860, varying from 591-1,104. In one of Baker's experiments a bar six feet long and two inches square broke at 903lb. It is used for indoor household work, carriage shafts, agricultural implements, rice-pestles and boat-building, and is one of the best of the second-class woods now coming into general use.

Terminalia Chebula, Retz.—*Har, harara.* Brandis, 223. This tree occurs in the Siwálik tract and outer hills ascending to 5,000 feet and along the hot valleys in the interior. It attains a height of 60-80 feet and a girth of 5-10 feet. A cubic foot of seasoned wood weighs 54-60lb. The timber is of a brownish colour, close-grained, heavy, capable of taking a high polish and fairly durable. It is used for furniture, indoor household work, and agricultural implements. *T. belerica,* Roxb., the *bahera* of the submontane tract, yields an inferior wood, of little value, though used for planks.

Anogeissus latifolia, Wall., *Conocarpus latifolia,* Roxb.—*Dhauri, bákli, dháwa.* Brandis, 227. This handsome tree is common over all the submontane tract and is found in Dehra Dún, imparting a fine copper tint to the foliage of the forests in winter. It attains a height of 60-70 feet, with a girth of 6-9 feet. The timber is close-grained, of a brown colour, hard, tough, and elastic. A cubic foot of the seasoned wood weighs 57-65lb, and of the unseasoned wood 75-80lb. The co-efficient of transverse strength, according to Skinner, is 1,220, but is placed much lower by others. From its elasticity, the *bákli* variety is especially fitted for cart-poles, axles, axe-handles and the like, and it is gradually coming into great demand as the prices of the superior timbers have risen. It is well fitted for all house-building and agricultural purposes, though said to be not very durable when exposed to moisture. The bark of the *bákli* variety appears to be of a lighter colour than that of the *dhauri* variety, while the leaves are smaller and it grows to a greater height.

Adina cordifolia, H. *f. et* Benth.; *Nauclea cordifolia,* Roxb.—*Haldu.* Brandis, 263. The *haldu* occurs abundantly in the open plain along the foot of the hills from the Sárda to the Rámganga *and less commonly westwards through the Dehra Dún to the Jumna.* It ascends the valleys to 3,000 feet. It is not gregarious and is remarkable for its trunk being often buttressed like that of the *semal.* Trees 60-100 feet high and with a girth of 10-18 feet are not uncommon in the Bhábar. The average weight per cubic foot is 42lb., varying 36·3-49lb. The co-efficient of transverse strength is about 700. The wood is yellow, smooth fibred and fine-grained and is fairly durable. It seasons well, works easily and takes a fine polish, and is suitable for turnery, though sometimes apt to warp and crack. It is now much used for indoor household work, planks, boxes, the keels of boats, combs, writing-tablets, gun-stocks, and agricultural implements.

Stephegyne parvifolia, Korth.; *Nauclea parvifolia,* Roxb.—*Kaim, kangai, phaldu.* Brandis, 262. This tree is gregarious, though occasionally met solitary in the open plain. It grows to a height of 50-60 feet, though specimens of 80 feet have been recorded and the average girth is 6-7 feet. The weight of a cubic foot of seasoned timber is 35-47lb., of green timber 54lb., and the co-efficient of transverse strength is 586-683. The timber is durable if not exposed to moisture and is applied to the same purposes as the preceding. This and all other woods of the sub-montane forests, except *sál, sissu, tún,* and *sándan* come under the designation '*Katrukh.*'

Quercus semecarpifolia, Smith—*Karshu, sauj.* Brandis, 479. This species occurs at high elevations 8,000-10,000 feet. Madden records it at Naini Tál. It attains a height of 70-80 feet, and a girth of 7-8 feet is not rare. It grows slowly and gives a hard, heavy timber that will not easily bear export, but on the spot is used for house-building, bedsteads, poles, helves and ploughs. It is said to warp on exposure and to be liable to the attacks of insects.

Quercus lanuginosa, Don.; *Q. lanata,* Wall.—*Rianj, rai-bánj.* Brandis, 481. This species occurs at Naini Tál and a few other places in Kumaun, 6,000-7,500 feet. The word is of a greyish-brown colour, hard and very heavy, and is not easily worked. *It is much liable to the attacks of a small black hymenopterous* insect which often riddles it completely in a few years.

Quercus dilatata, Royle ; *Q. floribunda,* Lind.—*Tilonj, kilonj, moru.* Brandis, 482. This species is common on the outer ranges from the Jumna to the Sárda at 4,500-9,000 feet. Pearson notices the noble forests of this oak in the valleys of the Bhágirathi and Jumna rivers. It attains a height of 80-90 feet and a girth of 8-9 feet, and Madden records one 100 feet in height and 19′ 8″ in girth. The wood is of a brownish colour, hard, durable and heavy. It is used for agricultural purposes and house-building and is considered the best of all the oaks for carpentry.

Quercus incana, Roxb.—*Bánj.* Brandis, 482.

This species is common on the outer hills from the Jumna to the Sárda. It generally attains a height of 20-30 feet, with a girth of 4—5 feet. The wood is used for house-building and agricultural purposes and ranks second to the preceding in popular estimation. Madden records *Q. annulata,* under the names '*phaliant*' or '*phaniat,*' as occurring in Naini Tál ; it is the *pharonj* of Eastern Garhwál.

Buxus sempervirens, Linn.; *B. Wallichiana,* Baillon.—Box—*Pápari.* This tree occurs in the upper hills at 6,000-8,000 feet and is common in the Bhágirathi, Jumna, and Tons valleys. The wood is very close-grained, hard and heavy, weighing 60-65lb. per cubic foot, and selected pieces are fitted for all the purposes to which European box is applied.

Acer oblongum, Linn.—*Patangliya, kirmuli.* Brandis, 110. This species occurs up to 6,000 feet in the great valleys. It is used for agricultural implements and from its knots some of the better wooden drinking-cups exported to Tibet are made. A considerable number of these cups are made from the knots of *A. pictum,* Thunb., which is common in the hills above 7,000 feet, and is also used for agricultural purposes and house-building.

Betula acuminata, Wall.—Himálayan Birch—*Puya-udish* or *utis,* Brandis, 458. This tree occurs in sheltered places 6,500-10,000 feet on all the outer ranges. The wood is close-grained and takes a fine satin polish. It is particularly good for panels for doors, and the examples in the Government-house at Naini Tál show that it is a valuable acquisition for ornamental work. The alder, known as '*udish,*' is the *Alnus nepalensis,* Don., which occurs at lower elevations and is also used for house-building purposes and gives a fair-sized log, from which planks may be cut for tea-boxes and the like. The wood is light and somewhat brittle, but takes a satiny polish like the birch. The people towards the snows use the bark of the silver birch (*Betula Bhojpatra*, Wall.; Brandis, 457) for writing and packing in place of paper.

CONIFERS.

Conifers.

As already noticed, the conifers constitute the most valuable section of the timber-producing trees of the upper Himálaya both for quantity and quality. In many parts of the country they occur in unbroken masses extending over many miles and present a scene of magnificent grandeur unknown elsewhere. Each species has its own peculiar beauty, but perhaps the wide-spreading cedar with its branches almost reaching to the ground is the finest and well deserves the epithet 'divine-tree' given to it by the old Hindu poets and still in common use to designate it from Kashmir to the Ganges. We have added Stewart's analytical key to the conifers and a list of vernacular synonyms compiled from the writings of Cleghorn, Madden, Stewart, and Brandis, which seem necessary in order to understand the very confusing local nomenclature :—

Analytical key to the chief arboreous Conifers of the North-Western Himálaya by the late J. L. STEWART, M.D.

	1.—Pinus longifolia, *Roxb.*	2.—P. Gerardiana, *Wall.*	3.—P. excelsa, *Wall.*	4.—Cedrus Deodara, *Loud.*
Crown	Young, ovate; older long ovate, with broadish top.	Short ovate, bushy	Conical, long ovate	Pyramidal, ovoid conical, or compressed columnar.
Branches of a tree in the open.	Begin high, droop somewhat, then upcurved.	Begin low, straightish, horizontal, curving up at ends.	Begin low, sub-horizontal, ends upturned, when not fruit-laden.	Begin low, straight horizontal.
Colour of the foliage.	Young, light; old, dark green,	Darker green than 1, and grey branches showing through.	Bluish or greyish green	Lightish green, young; very dark, old.
Bark	Rough, grey plates, and deep irregular furrows.	Large, long, greenish-grey plates, peeling off, darker under.	Dark, smoothish, furrowed into irregular, small whitish plates.	Dark, smooth, cut into long, narrow scales, by vertical fissures.
Leaves	6-18″ long, in 3s, stiff, erect, in persistent sheath, 6″-12″ long.	3″ long, in 3s. Stiff in deciduous sheath.	6-7″ long, usually in 5s, thin, drooping, sheath caducous.	1″ or more long, trigonous, stiff, sharp, in tufts of 30-40, on short branchlets, at last scattered.
Duration of leaves.	2-3 years	2-3 years	4 years	5 years.
Cone	Pendulous sub-globular or ovate, young; old conical, 5-7″ long, 13″ girth at base, brown.	Erect, young sub-globular old ovate oblong, narrowed upward, 6-9″ long, 14-15″ girth low, bluish.	Pendulous, tight, conical, cylindrical, 6″ long, 5-8½″ girth, resinous young bluish green.	Erect, thick cylindrical, oval or oval-oblong, obtuse, 3½-4″ long, 7½-9″ girth, dark brown.
Scales	With very thick knobby points, persistent.	Thick, spinous apex, persistent, seed edible.	Close imbricate, acute edged, terminal thickish umbo persistent.	Close imbricate, broad, thin, deciduous.
Ripe	(October) April-May	October	October	October.

	5.—Abies Smithiana, *Forb.*	6.—Picea Webbiana, *Lind.*	7.—Cupressus torulosa, *Don.*	8.—Taxus baccata, *L.*
Crown ...	Tall, narrow, cylindrical ...	Very narrow, cylindrical ...	Long conical, like garden cypress.	Broad oval, irregular.
Branches of a tree in the open.	Begin low, horizontal, or downward, with tassel-like twigs.	Begin low, short, declined ...	Begin lowish, of young horizontal, sub-declining; of old horizontal, with drooping, sub-divided tips.	Trunk short or none, branches lax, irregular.
Colour of the foliage.	Like 3, but with a rather darker tinge.	Very dark	Young, bluish green; old, darker, like (but browner than) 6.	Darkish green.
Bark ...	Very smooth, cut into small quadrangular plates by shallow furrows.	Young, smooth silvery; old, grey, cut into long narrow scales by anastomosing spiral clefts.	Brown, smooth, sulcate, fibrous, peeling off in long strips, often sub-twisted.	Young, silvery, old, smooth, brown, fibrous, compact, not sulcate, peeling off in layers.
Leaves ...	1½″ long, compressed tetragonal, stiff, sharp, solitary, scattered all round branches.	2″ long, 2 pointed, a silvery band on each side under, quasi-bifarious.	Scale-like, quadrifariously close imbricate.	Flat, falcate, entire, sharp mucronate, alternate distichous.
Duration of leaves.	8-10 years	8-10 years	?	?
Cone ...	Pendulous from tips, oblong cylindrical, sub-narrowed upward 3-4½″ long, 4½-5½″ girth, brown or purplish.	Erect, sub-globular or oval cylindrical, narrowed above, 3-4½″ long, 5-9″ girth, dark purple	Globular or sub-oval, 6″ long, 1½″ girth, fuscous, bluish, glaucescent.	Sub-drupe, 4-5½″ long, 1⅙-1½″ girth, cup red, fleshy, nucule greenish olive.
Scales ...	Thin, membranous edged, persistent.	Broad, thin, dark, deciduous,	Each scale with 4-6 facets ..	...
Ripe ...	October	October	October-November ...	September to January.

Local names of the Conifers of the North-West Himálaya.

	Pushtu.	Hazárá.	Kashmír.	Chamba (Chináb and Ravi).	Kulu (Biás).	Basáhir (Satlaj).	Garhwál.	Kumaun.
Cedrus Deodara (deodár or cedar).	Nakhtar Lmanza.	Deodár Diar. Palúdár.	Deodár Diár.	Kalain Kilei. Kelú keoli. Kilár. Deodár, diár.	Kelu Keli. Keori.	Kelon Kelu. Kiali, keltu. Keyúl. Kelmung (Kunáor). Gyam (Tib).	Deodár Diár.	Deodár Diár. Diwár.
Pinus excelsa (lofty pine).	Piuni (Káfir).	Biár	Chíl, chír Biár. Yári, yiro. Yur.	Chíl, chíltu Chíli, tser. Lhem, lhím. Yar. Shomshing (Lahoul).	Kail	Chíl Lím (Kunáor). Kail.	Kail Chíla. Darchilla.	Lím (Byáns). Rái-salla. Lamshing(Bhot).
Pinus longifolia (long-leaved pine).	Nakhtar	Chíl Chír.	Chíl	Chíl Dráb-chír.	Chíl	Chír-sthi (Kunáor). Chíl.	Kolon Kolain. Kalon. Salla, salli. Saral (Jaunsár). Chíl. Thansa (Tihri).	Salla. Chír. Sapin.
Pinus Gerardiana (Gerard's pine).	Chilghoza Jalghoza. Sananbar-saghar (?).	...	Neoza(seeds).	Chiri Galgoja. Galboja. Mirri. Kashti (Ravi). Prita.	...	Ri (Kunáor) Rhí (ditto). Shanti (Tib). Kuminche (Shipki). Koniúnche(ditto).	Konecha Kolecha.	Does not occur.

Abies Smithiana (Himálayan spruce).	Wesha ... Bajúr.	Kachan ... Kachal.	Kachal ... Kachan.	Tos, tosh ... Ráo, re. Rág, roi. Kánli. Bang re. Krok.	Sarai ... Rái. Rewári. Ban-lúdar. Sangal. Salla. Salle.	Bháj-rai (Shatúl). Bang-rai (Rúpin). Krok (Kunáor). Raiang, re. Roú (Kunáor). Ran. Kandrau. Kudrau.	Kandre, kail, kilu. Re, rhái, rho. Riálla. Rágha (local). Rái (Jaunsár). Téé (Bhot). Kudrau. Morinda.	Does not occur?
Abies Webbiana (Webb's fir).	...	Yalúdar (Jhelum). Rewari (Jhelum).	Rayal ... Badar. Búdar. Túng.	Dhunu ... Rág, sara. Rail, salle Pe, re.	Tos ...	Krok, kalrai ... Pindrow (Hattu). Pindrai (ditto). Thanera (Shálí). Chilrau (Chúr). Khatrou. Spun, pun.	Morinda ... Ráisalla. Rao rágha. Kúlu.	Rágha. Wúman (Byáns). Rausla Raisalla.
Cupressus torulosa (Himálayan cypress).	...	...	...	Debidiar ...	Deodár ...	Shúr (Kunáor) ... Gaia, galrai. Galain (Shálí). Kalyán	Leor (Tírhi) ... Leori (Jaunsár). Súrúi. Súrye.	Saru. Súrúi. Surái.
Taxus baccata (yew).	Saráp? ... Badar	Birmi ... Túng.	Sangal ... Tung. Túni. Postil. Sungcha.	Dhono ... Chogú. Kantú. Barma.	Rakhal ...	Geli ... Thuna. Kadeurú. Rikhalung (Kunáor). Yamdal (ditto). Ikalung.	Thaner ...	Thanera. Thúna. Lúet (Juhár). Nhare (Byáns).
Juniperus excelsa (pencil cedar).	Apúrs ...	Charái ... Chalái (Jhelam.)	...	Lewar, leor ... Shúr. Devdár.	...	Shúrbúta ... Shúrgu. Shúkpa (Tib). Neur-shúkpa. Shúr (Kunáor).	Lewar ... Dhúpri. Chandan.	Dhúp. Padmak (Bhot). Súrgi.

Pinus longifolia, Roxb.—Long-leaved pine. Madden, J. Agri.-Hort. Soc. Cal., VII., 75 : Brandis, 506 : Cooke, 125 : Roxb., 677.

The long-leaved pine. *Chír* (in Sanskrit "*kshíra,*" or "milk"), *sula* (Sansk. *sarala,* "straight") in Kumaun ; *kolon, kolan, kolain* in Garhwál ; *saral* in Jaunsár ; *thansa* above the Dún ; *dhúp* in Oudh. To the west of Garhwál the name *chír* or *chil* is applied to *P. excelsa,* except in Kunáor, where *P. longifolia* preserves the name *chír* with the indigenous affix '*sthi*' or '*shthi*' (M.)

Distribution.

The *chír* occurs all through the Kumaun Division, dividing the forest with oak, from 1,600 feet above the level of the sea at Sítakoti, eight miles above Deoprayág in Garhwál, to 7,200 feet on the Pindar river. The limits at which it is found vary much in different parts of the Himálaya between Afghánistán and the Tísta, and apparently the upper limit descends the further east we proceed from Kumaun.[1] As a rule, however, 2,500 feet is the lowest height at which it seems to flourish. The *chír* appears to have the power of driving out all other vegetation from the tracts it occupies, and forests of these trees are interpersed only with scanty underwood of the smallest shrubs. Madden and Brandis note the curious phenomenon observable in many of these pines in Kumaun. This consists in the spiral arrangement of the bark and woody fibre, the coils being sometimes as much compressed as those of an ordinary corkscrew, and in some instances the stem itself is thus distorted. Straight trees are found mixed with these contorted specimens in the same forest in Kumaun, and they do not appear to occur in Garhwál or in the higher ranges in Kumaun. The straight variety is known in Kumaun by the term *sapín.* The wood of the straight variety is usually of a reddish white colour, and is preferred for building purposes, as the other is liable to warp and split in working, though in the log form capable of bearing heavy strains. It is, however, rarely used except as fuel. Dr. Jameson thinks the crooked variety is confined to localities with a southern aspect and under 5,000 feet, but the fact remains that crooked and straight trees occur in the same forest with the same aspect, as may be observed near Ganái and Pyúra.

[1] Hooker gives the upper limit in Sikkim as 2,000-2,500 feet; Griffith fixes the lower limit in Bhután at 1,800-2,000 feet. At Rámesar bridge on the Sarju in Kumaun, 1,500 feet above the sea, it descends to within a few hundred yards of the river.

Webber's survey.

The forest survey of 1865-66 estimated the total area under *chír* as 413,650 acres in Kumaun and 152,264 acres in Garhwál. Many acres of forest contain 20 large and 50 small trees per acre; but in a square mile the bare places bring down the average to 20 trees per acre. First-class trees are those having a girth at five feet from the ground of eight feet and over; second class have a girth five to eight feet; third class, two feet to five feet, and fourth class under two feet. The first-class trees average about one-twelfth, the second about one-fifth, and the third about one-third of the total number per acre. This would give a total of about twelve million *chír* trees in the Kumaun Division, of which one million belong to the first class.

The forests lying along the Gúmti, western Rámganga and eastern Rámganga approximately contain the following trees:—

	Acres.	*Trees per acre.*			
		1st.	2nd.	3rd.	4th.
Sources of the Gúmti towards Baijnáth ...	61,440	3	5	5	7
Upper Sarju from Kapkot and Phúngar valley to Bágesar.	42,380	2	4	5	0
Middle Sarju from Bágesar to Naini bungalow.	28,280	1	3	5	7
Lower Sarju and Rámganga from Naini to junction with the Káli.	40,020	2	8	5	7
Middle western Rámganga from Ramári ..	11,700	1	2	0	7
Lower western Rámganga and Katyúr river.	22,085	1	2	4	7
Between Bino and the Rámganga beyond Lohba.	32,300	2	5	8	12
Between Badhángarh and Latugarh ...	16,000	3	12	12	12
In the Taráy Tál valley ...	5,760	2	12	0	12
In the Gúmti valley ...	8,960	3	10	10	7
To the west of Bud'ha Kidár and Bikya-ko-sain, to the east of Mási bungalow.	11,400	1	8	7	13
The Soni jungle	2,500	4	5	9	31

Nearly all these trees grow on slopes rising from the river-beds, and near enough to repay the cost of cutting and launching. The trees on the upper western Rámganga and its tributaries are mostly twisted, though towards Búngidár they are straight and so placed as to be easily shot into the Bino river. Following the stream of the Rámganga, the north-east banks from Garoth down to Bagri have first-class timber covering all the slopes of the Badhángarh and Gopálkot ranges, and could be easily worked into the Rámganga. The Syúni jungle near Dhaun Debi is one of the finest in Kumaun. The large trees have all straight boles without a knot and with much red wood. The soil is light, micaceous sand on loose beds of earth and stones, which appears to be eminently suited to the *chír*. In Garhwál there are extensive *chír* forests in the valley of the Alaknanda and along the Pindar from Chuding (4,800 feet) to Gwáldam (4,300 feet), a distance of thirteen miles. In the three upper miles the timber is small, but lower down there are fine straight trees close to the river-bank, and a flat near Chiringa suitable for a timber depôt. All along here and up the Kailganga, for two miles, the forest could easily be worked. The forests on the Mandákini and Madmahesvar rivers have been worked for railway sleepers, but in many places the timber is too remote from the river for removal. The forests along the Nayár and Chhípalghát rivers are extensive and yield good straight timber.

In native Garhwál there are almost inexhaustible forests of *chír*, along the Bhagirathi between Sainsu, some twenty miles above Tihri and Bhatwári, a distance of fifty-five miles. There are numerous patches along the head-waters of the Jumna and the Tons, and the left banks of both rivers are clothed with one immense forest capable of supplying all possible wants. Describing these forests Colonel Pearson writes:—"It would be difficult adequately to describe the enormous seas of *chír* forest which line its bank. In these the trees must be numbered not by thousands but by hundreds of thousands, and many of them are of huge size." The lower hills towards the Dún and the Siwáliks themselves contain large quantities of pine, and taking the entire forest area of the hills, the long-leaved pine may be considered the characteristic tree for quantity, but for quality it ranks below several other conifers. The great object at present is to find some inexpensive process for preserving it from the effects of exposure by creosoting or covering it with a permanent silicious coating. The *chír* grows even in the plains and specimens can be seen at Meerut and Saháranpur. It occurs, as we shall see, in every sub-division in the hills in abundance and in places from which it can be easily removed. It is often used for boat-building, but boats made of it seldom last for more than seven or eight years. Where *deodár* can be procured for the outside and *chír* for the inside the combination is excellent. *Chír* is easily worked into planks and beams and does well for interior work in houses. The bark is used in the preparation of charcoal for smelting iron. The knotty wood is used for torches, and the charcoal of the burned leaves with rice-water makes a fair ink. The growth of this pine may be calculated from observing the number of rings contained in a transverse section of the trunk. Of eight trees taken as a fair sample, Mr. Webber considered the largest, nine feet in girth and 200 feet high, to be 264 years old, and others, with an average girth of 5′7″ at five feet from the ground and a height of 93 feet, to be 154 years old. The growth is fairly rapid, averaging four or five rings to the inch. In the Turág Tál valley a fallen tree at five feet from the ground girthed 13′6″, and at 66 feet from the ground the girth was ten feet. The extreme height was 169 feet, of which over 100 feet were clear of branches.

The following table gives the measurements of several trees near Ránikhet :—

Aspect.	*Rings.*		Age in years.	Girth at 5 feet from ground.	Girth at 50 feet.	Height.	Locality.
	Heart.	Sap.					
				Ft. in.	Ft. in.		
N. W.	15	50	65	3 3	1 0	75	Ránikhet.
S.	106	145	251	8 0	6 0	120	Elevation 5,000 feet.
N.	104	100	204	7 0	5 0	110	
N.	110	154	264	9 0	7 3	120	Syáhi.
S.	52	23	75	3 8	...	75	Mansi mica rock.
S. E.	80	46	126	6 6	...	100	Ditto sandstone rock.
N. W.	28	52	80	4 5	...	60	Shaltángarh.
N. W.	80	90	170	7 6	...	80	Ditto.
S.	96	90	186	7 8	...	130	Pachrár nadi.

The following table shows the result of experiments made in Almora in 1844 towards ascertaining the transverse strength of *chír*. As far as No. 10 the distance between the supports was four feet, and the bars used were two inches square. From 11 to 20 the distance between the supports was increased to eight feet, the depth of the piece used to 2½ inches and the breadth to 3 inches :—

Number.	Specific gravity.	Weight producing deflection of		Breaking weight.	Remarks.
		½ inch lb.		lb.	
1	·545	540		1,000	Broke at a knot.
2	570	624		1,144	Red coloured and rather knotty.
3	·552	508		940	Large coarse grained.
4	·590	1,112		1,372	
5	·590	1,000		1,444	
6	·670	1,030		1,420	
7	·634	820		1,132	
8	·673	940		1,288	
9	·710	1,036		1,540	
10	·600	704		1,304	Apparently the best piece, though all were very good.
		1 inch.	2 inch.		
11	·665	412	702	1,108	Coarse grain.
12	·726	680	1,324	1,763	Quite free from knots.
13	·707	630	1,288	1,744	A few small knots.
14	·615	484	976	1,756	No knots.
15	·625	568	1,132	1,420	Good wood, but broke at a small knot.
16	·591	456	844	1,168	
17	·585	400	764	1,208	
18	·575	490	1,036	1,648	Very evenly and fine grained.
19	·601	344	680	1,168	
20	·602	484	904	1,300	

The quality of the timber varies with the locality in which it has been raised, the slow-growing timber of the upper and colder regions being much better than that of the rapid-growing timber of the hot valleys, and from this fact may be derived an explanation of the difference in the results of experiments as to its strength and weight.

Pinus Gerardiana, Wallich. Neoza pine: Gerard's pine. The *rhi*, *ri* of Kunáor; *shangti* of lower Kunáor: *newr* further down the Satlaj; *ruminche*, *ronhunchi* of Shipki and Hangrang; *ronecha*, *rolecha* of Juhár in Kumaun; *neoza* (the seeds).

The Gerard's pine is found between Malári and Bampa in the Dhauli valley in Garhwál, which seems to be its eastern limit, and locally in the upper valleys of the Tons and Jumna. It is generally associated with the cedar and is probably the *sanaubar-saghar* or 'lesser-pine' of Afghánistán, its height seldom exceeding 50 feet. It rarely gives a larger girth than eight feet and is preserved for its seed, which are collected and eaten and form a part of the *chilghoza* of the bazars. Brandis notes that the wood is used for the hook which supports the passenger's seat on the single-rope swing-bridge. Baskets and rough water-buckets are made from the bark. The cones are plucked before they open and are heated to make the scales expand and to get the seed out. The seeds are about an inch long, nearly cylindrical, with little or no wing, and are very palatable with a slight and not unpleasant flavour of turpentine. Large quantities of the seeds are stored for winter use, and they form a staple food of the Kunáoris, amongst whom the proverb is current, 'One tree, a man's life in winter.' The range varies from 5,800 feet (on the Marru river) to 12,300 feet near Sungnam. In Garhwál it occurs between 6,000 and 10,000 feet.

Pinus excelsa, Wallich, *P. Peuce*, Griseb.; *P. pendula*, Griff.—Lofty pine.[1] *Chil, chir, chilu*, to the west of Jaunsár, wherever *P. longifolia* is known by the name *salla*; *chila* and *karchilla* in Garhwál; *kail* and *chil* in Jaunsár; *dol chilla* in Kumaun; *ráisalla* in Central Kumaun; *lim* in Byáns; *lamshing* amongst the Bhotiyas of Dárma. Madden, Jour. Agri.-Hort. Soc., Cal., VII., 80: Brandis, 510: Cooke, 824.

This pine occurs in Upper Garhwál, on Rikholi Gudari (a spur from Trisúl), about Kanol near Rámni, and on Tungnáth; along the Dhauli to the Níti pass and in Byáns and generally only on spurs issuing directly from the snowy range. It seems to be absent in Central and North-Western Kumaun, but occurs near Dhákuri. The limits between which it flourishes in this portion of the Himálaya have been estimated at from 5,000 to 12,000 feet. The forest survey of 1865-66 gives the total area under this tree at 2,100 acres in Kumaun and 14,042 acres in Garhwál. The following are the principal localities, with the size of the forest and the number and class of each tree per acre:—

Locality.	Acres.	*Trees.*			
		1st.	2nd.	3rd.	4th.
Kanol Shatúl on the banks of the Nandákini ...	782	1	3	4	4
Above Sirka near Titalakot on the Káli ...	100	1	1	2	4
On the Vishnuganga near Pandukeswar ...	1,200	0	2	3	4
On the left bank and between it and the eastern Dhauli.	3,500	1	3	4	5
On the left bank of the Dhauli	3,000	5	5	6	6
On the left bank of the Rishiganga and near Tapuban,	5,050	2	4	5	5
Along the Kúnti river in Dárma	700	0	4	6	10
On its lower course	1,400	1	6	10	10

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[1] This name seems a misnomer, for though specimens occur up to 150 feet, it is not distinguished by its height from the other pines and is more of a silver-fir.

The Vishnuganga forests are inaccessible except near Pándukeswar, and those along the Rishiganga, Dhauli, and Kúnti rivers are practically excluded from the market by their distance from the plains and the difficulties of transport. There are considerable forests of this pine near Datmer on the Tons and on the right bank of the Rupin, and generally throughout the cedar tracts and above them it occurs in quantity. The grain of the wood is close and soft in working. The sapwood is whitish and the heart-wood light-brown and streaked with red. It is in some demand for house-building, though ranking below the cypress for durability. It does not stand exposure to excessive moisture. In the form of planks it is said to warp badly when exposed to the sun, and to become affected by dry-rot if placed in contact with damp earth. The highly resinous, small, knotty branches are used for torches, and the charcoal of the entire tree for smelting iron. The tree grows to a great size, the average girth of the larger trees being 13 feet. The rings average fifteen to the inch and the weight of a cubic foot is about 25lb, with a specific gravity of ·686. A piece of this timber of average quality, 22 inches long and one inch square, broke with a pressure of 368lb.

Cedrus Deodara, London; *Pinus Deodara*, Roxb—Himálayan cedar—the *deodár*, *diyár* of Kumaun and Garhwál; the *kelon*, *kelu* of Western Garhwál and Jaunsár, where the name *deodár* is given to the *Cupressus torulosa*: *deva-dáru* (divine tree), Sansk. Madden, Jour. Agri.-Hort. Soc., Cal., VII.: Brandis, 516: Cooke, 128: Roxb., 677.

There are no natural groves of *deodár* in Kumaun and only one large forest in Garhwál. There are numerous plantations around temples in Kumaun, aggregating about 800 acres. Amongst them may be mentioned those at Lodh, Bála-Jagesar, Pharka, and the groups at Súi, Rikhesar, Monkesar, Kalsia, Simalti and Ghatol near Lohughát, and Kshetrapál near Somesar. Along the western Dhauli between Kák and Malári there is a natural forest having an area of about 1,500 acres and giving one second-class, three third-class and eight fourth-class trees to the acre. At Lata on the Rishiganga there are about 70 acres of fine, healthy trees, one giving a girth of 30 feet, and at Parbati, near the Nandákini and Shatúl, there are some fine groves. The average girth of the largest trees in these provinces appears to be about 15-20 feet. Major Garstin measured some near Malári over 20 feet in girth at six feet from the ground. The cedar yields an oleo-resin similar to that of the *chír;* the oil is used in medicine and the twigs and branches are also said to possess medicinal properties. The great cedar forests of these provinces occur along the Bhágirathi valley and in Jaunsár-Báwar, and these are fully noticed in the accounts of those forests given hereafter. Dr. Brandis writes:—

"The *deodár* for the first three or four years of its life grows slowly, attaining 12-20 inches in height with spreading roots that do not go deep down. In this shrubby and stunted state the young plant can maintain its existence under the shade of other trees for considerable number of years without making much progress: but when light overhead is given, then a leader is at once formed which shoots up rapidly. At a more advanced age, the rate of growth of the *deodár* is determined without difficulty by counting the annual rings." The existing records show that the growth is influenced very much by the climate. In the dry valley of the Bhágirathi the rate of growth is much slower than in Jaunsár, where there is a heavy rainfall, so that in the former tract a tree takes 86 years to increase from 4′6″ to 6 feet, whilst in Jaunsár this is accomplished in 23 years. Within each tract also the rate of growth differs considerably. Colonel Pearson noticed in the Bhágirathi valley a stump 6′9″ in diameter with only 305 rings, and in another part of the same valley a tree with a diameter of only 4 feet showed 480 rings and two having a diameter of only 18 inches had 145 and 147 rings respectively. The wood in these slow-growing tracts usually has a closer grain and a deeper colour than the timber grown on southern aspects and in a moister climate. The soil too in these tracts is generally poor and is formed from the decomposition of granite, gneiss, and clay slate, and in the rapid-growing tracts the soil is richer and deeper. Isolated trees, such as those at Wán, often attain a great size. Dr. Stewart measured one at Kuársi in the Ravi basin, at an elevation of 7,500 feet above the level of the sea, 44′2″ in girth at two feet from the ground and 36′4″ in girth at six feet. Dr. Brandis records that one was measured at Parbani in Kunáor 34′4″, and that the girth attained by the largest trees there is 30-36″. Madden measured one between

Nachár and Taranda in lower Kunáor (in 1830) having a girth of 36⅜ feet at five feet from the ground. The tallest *deodár* measured by him was in the Nachár forest on the Satlaj, 250 feet high, 20 feet in girth at the base, and more than 550 years old, and there was a considerable number of trees in the same forests more than 200 feet high. Moorcroft measured a fallen tree on the Tugási hill in the Dhauli valley and found it 159 feet: another was 180 feet in height.

Many experiments have been made to ascertain the transverse strength of *deodár* taken from the Panjáb, the Garhwál, and the Kumaun forests. The weight of a cubic foot appears to vary from 25 to 40lb., but in Garhwál approaches more the latter; in one series giving an average of 37lb. A well, seasoned piece, 22 inches long and one inch square-broke at 345lb. It had a specific gravity of ·655 and showed eight rings to the inch. The result of eight experiments on Garhwál timber made at Rúrki (390-798) gave an average of 592. The result of a series of experiments at Almora in October, 1844, conducted by Captain W. Jones, ten with timber cut in the preceding month and ten with seasoned timber, is shown in the following table. In the first ten experiments the distance between the supports was four feet and the pieces were two inches square: in the second ten the distance between the supports was increased to eight feet and the pieces were 2½ × 3″ :—

Specific gravity.	Weight producing deflection of	Breaking weight.	Remarks.
	½ inch lb.	lb.	
·608	1,036	1,588	Good straight grained wood.
·710	1,024	1,636	Lower side split a little at 1,060.
·698	736	880	Not straight-grained and slightly flawed.
·669	1,060	1,540	Lower side split at 1,308.
·620	904	1,456	Ditto 904.
·585	680	976	Broke suddenly.
·574	680	708	Ditto.
·614	344	...	Ditto No flaw perceptible.
·586	568	1,204	Ditto.
·604	624	...	Lower side went at 624; uneven grained

Specific gravity.	Weight producing deflection of		Breaking weight.	Remarks.
	1 inch.	2 inches	lb.	
·641	350	704	820	Snapped suddenly: light-coloured; said to be outside of tree.
·618	400	788	1,028	Heart of tree red and oleaginous.
·644	344	660	908	Snapped short suddenly; light-coloured.
·570	428	876	1,116	Heart of tree very good and red
·578	344	736	964	Snapped suddenly, but was in appearance the best piece of all five.
·566	344	680	750	Good sound wood, but knotty, coarse and wavy in grain; snapped suddenly at knot.
·620	344	576	624	
·619	512	960	1,188	Dark cedar-coloured, fine grained; broke at knot.
·630	598	1,080	1,700	Dark cedar-coloured; under-side very fine straight grained and light-coloured.
·603	484	876	1,092	Dark cedar-coloured, but rather coarse in grain.

The timber of the *deodár* is the most highly prized of all the conifers for house-building, granaries, chests, boat-building, and railway sleepers. It appears to be little affected by extremes of heat, cold or moisture and is easily worked. In a climate like that of Kashmír it appears to be almost imperishable. Moorcroft states that the pillars of the great mosque erected by Aurangzeb at Srinagar showed no vestige of decay from exposure or insects at the time of his visit, and that pieces of *deodár* from the Zain-ul-kadal bridge were found little decayed, although exposed to the action of water for four hundred years. Many of the other bridges still standing in Srinagar may perhaps claim a greater antiquity. Gerard records some timber in a house in Basáhir as being 200 years old and as sound as the day it was cut. The cedar is a sacred tree in the hills and is in much demand for the temples, for the doors, walls, and roofs. Madden notes that he saw some beams in a Kanáor temple that were said to be 600 to 800 years old and showed no signs of decay, and though this may be an exaggeration of his informants, it indicates the popular belief. Boats built of *deodár* and lined with *chír* last from thirty to forty years, and for railway sleepers no other wood can compete with it. White-ants eat the sap-wood and but rarely attack the heart-wood, and neither the sap-wood nor the heart-wood is liable to dry-rot. Immense numbers of sleepers of this wood have been supplied from the

Bhágirathi and Jaunsár forests during the last fifteen years. The Jaunsár forests on the Deoban ridge between the Jumna and the tons were estimated by Colonel Pearson in May, 1869, to contain 34,000 available first-class trees and the Bhágirathi forests (excluding the Bhilang valley) 116,700 first-class trees. If to these are added the probable contents of the valleys of the Tons and Jumna rivers, the total number of first-class trees available in 1868-69 was about 500,000. The proportion of smaller trees may be gathered from the following estimate of those in the Bhágirathi valley :—

First-class or above 6′ in girth	116,700
Second-class or 4′6″-6′	53,600
Third-class or 1′6″-4′6″	127,536
Fourth-class, below 1′6″	213,281

Since 1868-69, however, there has been a great diminution of first-class trees to supply the numerous requisitions for railway-sleepers and public works.

Abies Smithiana, Forbes ; *A. Khutrow*, Loudon ; *A. spinulosa*, Griffith ; *Pinus Smithiana*, Wallich ; *P. Khutrow*, Royle ; *Picea Morinda*, Link.—the Himalayan spruce ; Smith's spruce—the *morinda* and *rái* of Jaunsár ; *kandre, re, rhái, ráo, kudrau, rái ála, rágha, kail, káluchilu* and *kiu* of Garhwál. Madden, Jour. Agri-Hort. Soc., VII., 87 : Powell, I., 564 : Cleghorn's analytical key to the Conifers : Brandis, 525 : Cooke, 127.

Smith's spruce, according to the survey, is found in the north of Garhwál near Joshimath and in the Dhauli and Vishnuganga valleys. The forest survey of 1865-66 estimated the area under this tree in Garhwál at 26,908 acres. The following are the principal localities, with the size of the forest and the number of each class of tree per acre :—

Locality.	Acres.	*Trees.*			
		1st.	2nd.	3rd.	4th.
Near Kanol, Peri and Shatúl on the upper Nandákini	6,328	2	3	4	4
On the slopes of Tamba Deo near the western Dhauli	50	1	3	3	3
Near Golábkoti on the left bank of the western Dhauli	2,050	5	5	5	7
On the Birignaga and Rishiganga ...	13,000	5	4	5	7
Further up the Rishiganga	4,980	2	4	6	8

Dr. Griffith describes this spruce as growing abundantly on the northern ranges of Bhután, 7,800-11,600 above the level of the sea, preferring northern aspects and occurring in masses below *A. Webbiana.* It is rare in Sikkim and confined to valleys of the inner range at 8,000 to 9,000 feet mixed with *A. dumosa* and seldom exceeding 50 feet in height. It has not been found in Kumaun, and Madden states that he was unable to detect a trace of it in Dánpur, Juhár, or along the snowy slopes of Nanda Devi and Nanda Kot. Nor were Bhotiyas of Milam, accustomed to traverse the mountains, able to recognise the cones or dried specimens. It is not mentioned in Webber's survey as occurring in Kumaun, but is said to be indigenous on Rikholi Gudari and occurs, as we have seen, in the valleys of the Nandákini and western Dhauli. On the left bank of the Bhágirathi above Jhala it is found with cedar, silver fir, and birch on the slopes having a northern aspect. It occurs also in the forests of the upper Jumna and Tons and in Jaunsár.

The spruce grows to an immense size. Webber mentions one on the Nandákini 18 feet in girth and 110 feet in height. Hodgson records the length of a fallen tree as 169 feet, and Madden gives the girth of ten trees as varying from 13½ to 20 feet and showing an average girth of 16 feet. Dr. Stewart has recorded one of 21 feet, but the average girth is from 8-12 feet with a height of 100-150 feet. As has been noticed, the spruce prefers a northern aspect, and this is but one of many instances of the phenomenon which strikes every traveller in the Himálaya, that of the northern and north-western aspects being densely wooded, whilst the south and south-eastern are wholly or almost bare. Baron Hügel, as quoted by Madden, thus refers to the valley of Perhamgala in the Pir Panjal range :—"Strange to say the south side (aspect) of the valley is everywhere wild and dreary, while fine trees grow up to the very summit of the mountain on the north face. The reason may possibly be found in the fact that on the south side the repeated action of alternate freezing and thawing destroys every kind of vegetation except a few grasses." The wood is white; the outer part turns red and decays rapidly if exposed to moisture, so that it is seldom used except for indoor work. A very dry piece 22 inches long by one inch square broke at 288lb., being the weakest in a series of experiments of all the conifers. The specific gravity was only 426, though the piece in question averaged 14 rings to the inch. The bark is used for roofing purposes and to make rough water-troughs for cattle, and the young cones form a part of the drug sold as *gaj-pipal* in the bazars.

Abies dumosa, Loudon ; *Pinus dumosa*, Don ; *P. Brunoniana*, Wallich—Hemlock spruce of Nepál—the *tungsing* of the Bhotiyas of Dárma in Kumaun ; *changathasi dhúp* of Nepál. Madden, Journ. Agri.-Hort. Soc., VII., 95 : Brandis, 527.

The forest survey in 1865-66 gives the total area in Kumaun under this tree at 3,650 acres. The principal localities, with the size of the forest and the number of trees per acre according to class, are as follows :—

Locality.	Acres.	*Trees.*			
		1st.	2nd.	3rd.	4th.
Dola Kot and Kála Mundi, to the west of the Gori river, mixed with *Abies Webbiana*.	140	1	2	2	4
In Chaudáns and Byáns, to the north-west of the Dhauli.	650	2	6	5	5
Manktil dánda and in the valley of the Chirkila gár, falling into the Dhauli.	1,160	1	2	3	3
At Titala Kot near the Káli	600	2	3	3	4
Spurs of Panch Chúla above Tínkar ...	920	2	4	6	6
In Byáns near the Káli	1,000	2	4	4	10

It was first discovered by Captain Webb in 1810 and again by Mr. Webber in 1863. Dr. Hooker found it in Sikkim in narrow gorges on the southern flank of Kanchinjinga at an elevation of between 9,000 and 10,000 feet. In the innermost valleys the limits are 8,500 and 10,500. The Gorkháli name there is '*thingiya*' or '*tingúri-salla*,' and the Bhotiya name is '*semadung*.' One specimen measured 27 feet in girth at five feet from the ground. Griffith found it in Bhután at 6,500-9,700 feet above the level of the sea, and it is said to be indigenous on Gosáinthán and Banopa. In Kumaun, it occurs in Dárma and about the Chipula range at 9,000-11,000 feet, and here it is called '*tungsing*' and attains a height of 80-100 feet, with an average girth of 10-12 feet. The timber is white, fine-grained and light, having a specific gravity of ·612, but is said to warp much from exposure. The bark is used for thatching purposes.

Abies Webbiana, Lindley ; *A. Pindrow*, Royle ; *A. densa*, Griffith ; *Picea Webbiana*, Loudon and Wallich ; *Pinus spectabilis*, Lambert—Himálayan silver-fir.

Madden separates the variety known as *Picea Pindrow*, Royle, from *A. Webbiana*, Wallich., though the names of both are the same in the vernacular ; *rágha* and *ráo rágha* in Kumaun ; *wáman* amongst the Bhotiyas of Dárma ; *bang, dodhma rágha, teliya* or *chíli rágha* in South-eastern Garhwál ; *chilrao* in Central Garhwál ; *morinda* in North-western Garhwál and Jaunsár ; *raunsla* or *rái salla* about the sources of the Kosi in parganahs Bárahmandal and Dánpur and on the Dúdú-ki-toli range near Lohba in Garhwál. Madden, Jour. Agri.-Hort. Soc., Cal., VII., 96 : Brandis, 528.

Madden thus describes his *Picea Pindrow* of Royle :—

"It flowers in April and May, when the young shoots are of the brightest green, the old leaves being nearly black. The trunk is branched nearly to the ground, but cones are produced only on its loftiest boughs. By the middle of May the cones are about 3 inches long by one in diameter and more or less cylindrical. As the season advances, they become more or less completely so, and of a rich dark purple colour. They ripen in October and November. The cones of *P. Webbiana* are less cylindrical, thicker and shorter, and the bracteoles more rounded, scarcely emarginate, and with a *thicker and longer apex*. The *spiral arrangement of the scales* seems identical, and each has the same copious supply of white resin. The cones of *P. Pindrow* are perfectly cylindrical ; the scales more prominently eared ; bracteoles oval, obtuse, eroded, emarginate, the mucro of the same length as the border of the sinus."

Localities.

This variety forms dense forests on all the great spurs towards the heads of the Pindar, Sarju, eastern Rámganga and Káli rivers : near the sources of the Kosi at Bhatkot and on the Dúdú-ki-toli range, near the sources of the western Rámganga.

The other variety is thus described as the *Picea Webbiana* of Wallich. :—

"Tree tall, very narrow and like the cypress. Branches short, thick, scrubby, and declining at the extremities. Foliage very dark green ; near its upper limit of a grayer colour. Bark somewhat smooth, tessellated by shallow furrows into small squares; young branches silvery. Leaves three-quarters of an inch to two inches long, flat with three small points, in two rows on either side of branches and twigs. Cone erect, rather short, cylindrical, dark purple, scales broad, dark-coloured near edge, deciduous. Ripe in October. The tree flowers in May, when the strobili are of a purplish red. Remarkable for its upright columnar appearance."

Localities.

It occurs at Rámni on one of the spurs of the Trisúl, between the Pindar and Alaknanda up to the glaciers, and on the summit of Dúdú-ki-toli. The forest survey, 1865-66, gave an estimated area for Kumaun of 13,110 acres, and for Garhwál of 53,280 acres. The principal localities, with the number of each class[1] of tree per acre, are as follows :—

Locality.	Acres.	*Trees.*			
		1st.	2nd.	3rd.	4th.
On the left bank of the Nandákini in Garhwál, at Chati Buklyál and Gúdari Buklyál.	790	1	1	7	6
At Shik, Kanol and Shatúl, near the same river	5,600	2	3	3	3
Above Kanoli in the Pindar valley ...	1,040	2	6	7	12
On the Kaliganga and above the Pindar .	1,230	1	6	8	9
On the Pindar from Gauna Páni to Chauding,	3,680	1	4	4	7
Between the Pindar and Sarju and east of the Rámganga.	1,800	2	2	3	3
About Munsyári	670	2	2	4	5
In Dárma, Chaudáns, and Byáns	2,900	2	4	6	8
On the spurs of Tungnáth, and in the valleys of the Nigholi and Balsákhi rivers.	4,370	2	4	4	5
To the left bank of the Alaknanda, on the Pilkánta and Ramni ranges.	6,070	4	4	6	8
On the left bank of the western Dhauli ...	15,100	5	5	..	8
On the upper Nyár	3,200	2	6	8	10
Dúdú-ki-toli range	8,800	2	6	8	10
On the spurs of Panch Chúla	3,010	5	5	7	8
Deo Thal in Agar Patti, Kumaun ..	3,200	1	2	4	4

The forests on the Pindar could easily be worked, and that river can carry the largest logs with ease. Those on the Balsákhi and on the Mandákini, near Kedarnáth, are too high up to be accessible. In the Bhágirathi valley, above Jhola, it occurs with cedar, spruce and birch, and in the upper valleys of the Jumna and Tons and their tributaries is abundant, associated with oaks. It is also found throughout Jaunsár along the ridges of the main range and of the lateral spurs and on Surkhanda near Masúri at an elevation of 8,200 feet. It occurs on the Dúdú-ki-toli range in Central Garhwál at 7,500-10,000 feet and on Tungnáth up to 11,200 feet. Brandis notes the limits in Jaunsár, Garhwál, and Kumaun to be 7,500-13,000 feet; it nearly reaches the latter elevation in the Munsyári district and in the Nandák valley ceases at 12,000 feet. Griffith states that it forms vast forests at 12,000 feet in Bhután, below the belt of rhododendrons, and in Sikkim, under the Gorkháli name '*gobriya-salla*' and the Bhotiya name '*dúngshing*,' it occurs abundantly in the zone 9,700-11,500 feet. The limits in the southern flanks of Kanchinjinga and crests of the inner sub-Himálaya are 10,000-12,000 feet, but in the inner valleys and rearward ranges 9,000-13,000 feet. In the north-west Himálaya, it thrives best in cold damp glens with a north or west aspect, and in such places, according to Brandis, constitutes alone or associated with the Alpine birch the upper forest belt. The silver-fir attains a height of 120-150 feet and an average girth of 9-15 feet, though specimens exceeding 20 feet in girth have been noticed. The wood is white, soft, rather coarse-grained and inodorous and is not much esteemed. It is not durable when exposed to moisture or the sun and is chiefly used for indoor work, though in dry climates where better wood is not obtainable it is split up and used for shingles. A piece 22 inches long and one inch square broke with a weight of 379lb. The specific gravity of this piece was ·491 and it showed 16 rings to the inch. The following table shows the results of some experiments on the transverse strength of the silver-fir made by Captain W. Jones at Almora in 1844. The distance between the supports in the first five experiments was four feet and the pieces used were two inches square. The distance in the last five experiments was increased to eight feet and the pieces used were 2½ inches in depth by 3 inches in breadth:—

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[1] Classes as in *chír*; first, 6 feet in girth and upwards; second, 5 to 6; third, 2 to 5; and fourth, under 2 feet.

Specific gravity.	Weight producing deflection of	Breaking weight.	Remarks.
	½ inch.	lb.	
·472	680	640	Broke at a knot one foot from the centre.
·550	512	880	Broke suddenly; no flaws perceptible; deflection ⅞ths.
·540	820	1,200	
·518	820	1,084	
·560	730	904	

Specific gravity.	Weight producing deflection of		Breaking weight	Remarks.
	1 inch.	2 inches.	lb.	
·436	344	652	780	Broke gradually; all very moist and soft.
·481	514	944	1,004	
·434	372	740	788	Broken at a knot.
·458	456	848	930	
·483	400	704	968	

Cupressus torulosa, Don—Himálayan cypress—*Súrái, surái*, Kumaun and Garhwál; *rái salla*, Naini Tál; *leauri* of Jaunsár; to the west and towards Simla it is called *deodár*; and the name *súrái* is given to *Juniperus excelsa*. Madden, *l.c.*: Brandis, 533.

Found in Chaudáns, Naini Tál, and of remarkable size near Rámni and Wán on the Kailganga in Garhwál, and from Joshimath to Níti. The forest survey of 1864-65 estimates 1,200 acres of cypress in Kumaun and 4,938 acres in Garhwál. The principal localities, with the number of trees in each, are as follows:—

Locality.	Acres.	*Trees.*			
		1st.	2nd.	3rd	4th.
Right bank of the Nandákini near Rámni,	17	1	3	0	10
Gúni, Búra, Barkuna, Shik, Ali Bukiyal and Wán, near the source of the Kaliganga.	601	3	3	0	6
On the Kailganga and at Ketha and Melkhet, on the Pindar and higher up.	378	3	4	5	4
Near Pándukeswar on the Vishnuganga, a difficult river.	150	...	2	3	4
On the left bank and near the slopes of Tamba Deo.	1,700	1	2	3	4
In the valley of the western Dhauli, from Samaughata to Malári.	1,585	1	2	4	5
Near Turág Tál	100	2	2	4	4
Naini Tál	100	2	4	6	6

In north-eastern Kumaun, it occurs along the Kálimundi range, separating the Rámganga from the Gori, but is apparently wanting in north-western Kumaun. The older trees in a favourable climate grow up in a slender column like the *A. Webbiana*, and, except that the foliage is a yellowish green, considerably resemble it in its sombre colour and columnar appearance. The thick contorted boughs also give it a rough appearance. At Naini Tál the boughs with a southern aspect are fuller and more regular, giving the tree a lop-sided appearance. The cypress occurs also in the Bhágirathi valley and along the head-waters of the Jumna and the Tons, and in Jaunsár-Báwar on the Lohkandi and Moila hills and below the Karama peak. In Munsyári it occurs at 7,000-9,000 feet; in Naini Tál at 6,500-8,000 feet and in the valley of the western Dhauli it abounds from 7,000-8,000 feet: "after leaving the oaks, elms, hornbeams, &c., the wood becomes entirely cypress, and from summit to base of the mountains no other tree is seen. The larger trees not unfrequently attain an enormous size, some of them having a girth of 27 feet." Major Garstin measured one at Wán over 38 feet in girth and several were over 20 feet. Madden writes:—"The famous cypress grove at Ming, four or five miles south-east of Joshimath, stands on the north-east aspect of the mountain at 7,500 feet elevation, surrounding the temple of Chandika Devi. Most of the trees are 12-16 feet round: but there is one 27 feet, measured flush with the ground on one side, 10 or 12 feet above it on the other: it is branched nearly to the base with enormous root-bole embracing rocks and is probably not under a thousand years old." The cypress has an average height of 60-120 feet and an average girth of 6-12 feet. These measurements vary much with the position and elevation. Above Malári, in the Níti valley, it is so dwarfed as to appear a mere bush, and its limits as a tree in Garhwál may be set down at 4,500-9,000 feet, but when introduced, it flourishes considerably lower, as at Háwalbágh (4,000 feet) and Diwángiri (2,000 feet). The wood is hard, tough, long-fibred and of a reddish colour, and was formerly extensively used for house-building in Naini Tál. Throughout Kumaun the timber is freely used for indoor work, and there is apparently no religious consideration prohibiting its use, but to the west of the Tons it assumes the name *deodár* and is solely used for incense. The timber when used is considered very durable, but too flexible for any position where great weights have to be sustained, and for this purpose oak is preferred. A piece 22 inches long and one inch square broke at 432lb., it had a specific gravity of ·695 and showed 18 rings to the inch. *C. sempervirens*, Linn., is occasionally cultivated in gardens in Kumaun at low elevations.

Juniperus communis, Linn. Varieties *alpina, nana;* ground cypress; *padma* and *parpinja* of Níti; *churpunja* of the Mána valley; *lhála* of Byáns, but H. Strachey names the *lhála* of Byáns *J. religiosa*; the *chlchiya* of Milam. Madden, Journ. Agri.-Hort. Soc., Cal., VII., 153-5: Brandis, 535.

It is found on Chitu Binńyak (10,500 feet); at Milam and Tola (11,000-12,000 feet), Bampa, Malári (10,500 feet); Jolam (9,000 feet), and Rimkim (14,000 feet), on the glacier-moraines of the Vishnuganga, west of Mána and in Kunáor. It is said to be used as one of the sources of incense and rarely attains a height of more than 7-8 feet with a stem 18-24 inches. It is used for fuel in Juhár. The aromatic berries are added to spirits distilled from barley and are also exported to the plains under the names *abhil, ahúber*, and are used in medicine as a stimulant and diuretic.

Juniperus recurva, Ham.—Weeping blue juniper; the *better, bhedara, jhora, gúgal, aru* and *agaru* of Kumaun and Garhwál; the *bil* of Milam; *padbank* and *páma* of Byáns. Brandis, 536. There are two varieties: one with acute spreading leaves, found at 12,000 to 13,000 feet; the other with imbricated cupressiform leaves and extending to nearly 15,000 feet. It flowers May-August and the fruit ripens July-November.

Localities.

It occurs beyond Milam and Níti (to 15,000 feet); in the valleys of the Dhauli (lower limit, 9,000 feet), Vishnuganga and Kedárganga, at Pindari and most other glaciers. Hodgson found it on the Bhágirathi at 12,914 feet, and describes it as having there the form of a large creeper, not a tree; some of the branches were 6 inches in diameter and of a considerable length; in some places they were above the spongy soil and in others below the surface. The wood is of a red colour, has a brittle and soft grain and the characteristic odour of the pencil cedar. It is one of the sources of incense and is apparently the *thalu, thelu* or *telu* of Basáhir. It is used in the manufacture of the yeast called *balma*, which forms an adjunct in the preparation of spirits from rice. The yeast is made by moistening coarse barley flour, which is formed into a ball and covered all round with the leaves and twigs of juniper. The whole is then closely wrapped up in blankets kept in a warm place and allowed to ferment, which usually takes place in three or four days.

Juniperus excelsa, M. Bieb.—Himálayan pencil cedar—*Shurbuta, shúrgu, shúkpa* of Tibet; *dhúp, padmak, súrgi* of N.-W. P.; *padmak* of Milam. Madden, Journ. Agri.-Hort. Soc., Cal., VII., 138-146: Brandis, 538.

This is another of the sources of Tibetan incense. It occurs at the upper limits of *A. Webbiana* (8,900-11,500 feet) beyond Milam; at Jelam on the Dhauli (9,000 feet) and in the valley of the *Girti*. *In Nepál it grows to a height of 60 to 80 feet*, and is there a fine large tree with dense branches of a dark colour and close foliage. In Sikkim it falls to from 15 to 20 feet. Hooker notes that the Sikkim tree has a scaly bark; the heart-wood is red and odorous, and the leaves are quadrifariously imbricated, and the wood is burned as incense. The juniper is often confounded with the cypress; the former, though the ultimate ramifications are very numerous, has them much shorter and less pendulous than the cypress, and the green is more brilliant. The leaves are closely imbricated in decussate pairs, somewhat obtuse, with a central gland or raised line on the back; four-ranked and imbricate; or slender, acute, *disposed in threes and spreading*. The fruit ripens in September-October, of a purplish blue colour, the size of a small pea, one or two-seeded, with a strong aroma when bruised. The tree does not usually attain any great height, seldom being more than 15-30 feet, with a disproportionately thick stem 2-5 feet at six feet from the ground and often 6-8 feet and in some cases much more. One at Súngnam girthed 13 feet at 5-6 feet from the ground, and Brandis mentions another in Láhúl with a girth of 33½ feet and only about the same height. The pencil-cedar occurs also in the valley of the Jádh-ganga at over 11,000 feet, and was first found there by Captain Herbert. Some logs of this valuable wood have been removed and *exported by the Bhágirathi river to the plains, but in the hills it is* only used for fuel or incense.

Taxus baccata, Linn.; *T. nucifera*, Wall., *T. Wallichiana*, Zucc.—Yew—*Thaner*, Kumaun; *lást*, Sor; *nhare*, Byáns. Madden, Journ. Agri.-Hort. Soc., Cal., VII., 155: Brandis, 537.

The yew is found at Bála Jagesar, 5,900 feet; Púya-páni, on the road to *Deo Dhúra, 6,500 feet*; on *Thákil in Sor; Kanol on* the Nandákini; Chúla in Chaudáns; Laduli ghát on the Nayár

(7,000 feet) and near Tungnáth, but is indigenous only on the spurs from the snowy range. It occurs with box and cypress in the Bhágirathi valley between Bhatwári and Jhola and along the head-waters of the Tons and Jumna. Griffith notes its occurrence in Bhután between 7,100 and 9,800 feet, and 8,000-9,000 feet would seem to be the limit within which it flourishes there. On the outer ranges in Sikkim it does not descend below 9,000 feet, but on the inner ranges it is found as low as 7,000 feet, and in Basáhir Madden has not seen it below 8,000 feet. In Garhwál poor scrubby specimens ascend as high as 11,200 feet at Kedárnáth and to 11,000 feet on Tungnáth. Hoffmeister records a tree near Gangotri, 15 feet in girth, and Dr. Hooker notes one of 18 feet in girth on Tonglo in Sikkim; but the average girth is not more than 5-8 feet and height 20-30 feet. The sap-wood is whitish, but the heart-wood is heavy, close-grained, and eminently fitted for turnery, taking a very high polish. The tree is held in high veneration and the wood is burned as incense and the branches are carried about in processions in Kumaun. The people of Ladák import yew-bark from Kashmír and use the inner part dried and prepared as tea or for mixing with tea and as a dye. The tree is there called *sungcha* and the bark *chaling*. The leaves (*birmi*) are exported to the plains and are used in medicine and the berries are eaten by the poorer classes. There is little export of the timber, which would seem to be well adapted for shafts and the purposes to which its European representative is applied, if it could be procured in sufficient lengths.

CHAPTER X.

Economic Botany—(*continued*).

CONTENTS.

Forest history. Grazing tax. Boundary disputes. Government forests. Kumaun forest-division. Naini Tál forest-division. Ránikhet forest-division. Garhwál forest-division. Dehra Dún forest-division. Ganges (Bhágirathi) division. Forest at the head of the Tons and the Jumna. Jaunsár forest-division. Rhea cultivation. Cinchona. Tallow-tree. Ipecacuanha. Cork-oak. Sweet-chestnut. Carob. Mezquit and others. Tea.

Forest history.

From time immemorial, the forests along the foot of the hills to which alone any fiscal value pertained as well as those within the hills were considered the property of the ruling power and as such invariably formed a source of revenue to the State. The most simple mode of realising this revenue was that actually adopted by subjecting the products of the forests to a small proprietary due in the shape of duties payable by the exporters. The products consumed within the hills by the people themselves were, as a rule, too inconsiderable to be taken into account and where exceptionally large, as in the case of fuel for smelting ores, were included in the revenue demand. These duties on ordinary forest produce were collected at stations along the foot of the hills, whilst the duty on catechu was fixed at so much per kiln and was paid by the manufacturers. For the first three years of our rule the forest dues were leased with the transit duties on merchandise, and on the abolition of the latter source of revenue, Mr. Traill was authorised to farm out the forest dues or *káth-báns* and *kath* mahábls as they were called from their principal items *káth* (timber), *báns* (bamboos) and *kath* (catechu), to the zamindárs of the parganahs in which they were collected.[1] The revenue from this source in 1818-19 for Káli Kumaun, Chaubhainsi, Chhakháta, Kota, the Pátli Dún and Udepur amounted to Rs. 3,200, as compared with Rs. 2,841 in the previous year. The following table shows the collections in sonat rupees for nine years under the new system :—

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[1] From Commissioner, 14th September, 1818. To Commissioner, 25th September, 1818.

Year.		Rs.	Rs.
1818-19 ...	Kumaun ...	2,644	
	Garhwál ...	556	
			3,200
1819-20 ...	Kumaun ...	3,327	
	Garhwál ...	662	
			3,989
1820-21 ...	Kumaun ...	4,038	
	Garhwál ...	812	
			4,850
1821-22 ...	Kumaun ...	4,579	
	Garhwál ...	924	
			5,503
1822-23 ...	Kumaun ...	5,368	
	Garhwál ...	934	
			6,302
1823-24 ...	Kumaun ...	5,733	
	Garhwál ...	1,368	
			7,101
1826-27 ...	Kumaun ...	2,266	
	Garhwál ...	1,100	
			3,366
1827-28 ...	Kumaun ...	2,294	
	Garhwál ...	1,381	
			3,675
1828-29 ...	Kumaun ...	2,620	
	Garhwál ..	1,405	
			4,025

In 1824, the collection of these dues was intrusted to the authorities of the Murádábád and Bareilly districts in consequence of the difficulties regarding boundaries that had occurred, but in 1826 the duty of collecting them was restored to the hill-districts. In 1828, the forest dues were leased to the farmers of the *charái* or grazing-tax at the same rate, as it was found that the two could not be then usefully separated.

Grazing-tax.

This grazing-tax was one of the many miscellaneous items of revenue that descended to the British from former Governments. From the earliest times, the landholders in the hills were all subject to a tax on their cattle known as *ghikhar* which with other cesses was abolished at the first settlement.[1] The practice of collecting these dues, whether for the Government or for the landholders, extended to the Bhábar and Tarái and was continued there under the name *gái-charái;* but the cattle of the hill-men were exempt from this tax, which was levied chiefly on the cattle of the villages in the plains that came into the forests during the hot season. During the two or three years succeeding the conquest the number of cattle proceeding from the hills to the Bhábar and Tarái was not so great as to render any cess on them an object of interest to the Government, but the security afforded by the abolition of the old rural guard (*chaukidári*) system and the introduction of an efficient police led to increased resort to the plains. It was therefore resolved in 1822 to subject all cattle sent to graze in the Bhábar and Tarái to a uniform tax of three annas for each female buffalo, two annas for each cow, and one anna for each bullock a year. The farm of this tax for the year 1822-23 was given out in three leases, aggregating Rs 2,077 per annum. The unsettled state of the boundaries between Kumaun and Rohilkhand became a fertile source of dispute between the farmers of this tax for the hill and plains portions of the submontane tract. Many of the hill-men having made their arrangements with the Rohilkhand farmers paid the duties to them and were again called upon to pay by the hill farmers, who claimed the right to levy these dues in all places in which the *chaukidári* cattle dues had formerly been collected. In 1823, the cattle belonging to the Kamíns, Sayánas, and Thokdárs or head-men of parganahs in the hills and to Padháns or head-men of villages in the Bhábar and those belonging to permanent residents were exempted from these dues. In 1826, the boundary between the hills and Rohilkhand was finally arranged and separate farms for the grazing dues were established. The principle on which the collections were made was that the farmer within whose jurisdiction the cattle-pens were situate was entitled to collect the tax. The dues were very rarely collected per head, the plan being to count in each *goth* or cattle-pen the *agals* or *donas*, that is the wooden bars to which the cattle were tied at night. The customary rate was to consider each *agal* as containing eight buffaloes and eight cows liable to a tax of two rupees.

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[1] To Board, dated 16th July, 1822. These cesses were called *ghikhar, gobar,* and *puchhiya* in the hills and were farmed out as *jagát*, and under the Heris and Mewátis in the Bhábar were called *donia*, from the *dona* or wooden bar to which the cattle were tied at night, and each of which paid one kuchcha ser of ghi and four pice a year.

Boundary disputes.

To make this point in the history of the management of the forests more clear, it will be necessary to refer to these boundary disputes. In the earlier years there were no exports of any value from the portion of the lowland tract lying below the chain of custom posts established to levy the export duty, and it was thought that no difficulty could arise in regard to the collections made there, but the unsettled state of the boundary between the Bhábar and Tarái and the conflicting claims of the landholders of the frontier villages, both of the hills and of the plains, soon led to innumerable complaints in which the district authorities on both sides found themselves partizans. The records show a voluminous correspondence on this subject extending over several years. Early in 1819, Mr. Traill reported on the encroachments made by the zamindárs of Bilhari on the forests lying along the foot of the hills now included in the Tallades Bhábar. This tract was valuable to the hill-men as affording them pasture for their cattle during the winter months when the grass in the hills dried up and became useless for fodder. During the Gorkháli rule a joint commission had been appointed by the Nepál Government and the Nawáb of Oudh to settle these disputes, and the Saniha nála was fixed upon as the boundary between the two states. The hillmen had always occupied the jungle to the north of this boundary and were anxious to undertake the cultivation of the portions lying at the foot of the hills which had recently been taken possession of by the Bilhari landholders.[1] It was agreed that an attempt should be made to settle the disputed boundary on the basis of that which existed in 1802, when Rohilkhand was ceded to the British, and that advantage should be taken of this arrangement to demarcate the whole line of boundary between Rudrpur and the Nepál frontier. The difficulty was much enhanced by the claims set up by Major Hearsey, who, in 1814, had purchased the entire taluka of Bilhari at auction for arrears of revenue and now demanded possession of a portion of the Kumaun Bhábar, on the plea that it belonged to the lowland parganah. A commission was appointed to investigate these matters, and it was at length decided that the Saniha nála had always been, and should continue to be, the boundary between the hills and the low country.[2] The collection of all dues was handed over to the plains authorities, but, in 1826, was again intrusted to the Commissioner of Kumaun.

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[1] To Board, dated 5th February, 1819.
From Board, dated 6th February, 1819.
To Collector, Bareilly, dated 1st March, 1819.
From Collector, Bareilly, dated 8th March, 1819.
To Collector, Bareilly, dated 20th March, 1819.
From Collector, Bareilly, dated 26th March, 1819.
To Collector, Bareilly, dated 5th April, 1819.
From Collector, Bareilly, dated 10th April, 1819.
To Collector, Bareilly, dated 5th November, 1819.
From Collector, Bareilly, dated 18th November, 1819.
To Collector, Bareilly, dated 24th November, 1819.
From Collector, Bareilly, dated 1st December, 1819.
To Collector, Bareilly, dated 10th February, 1820.
From Collector, Bareilly, dated 24th February, 1819.

[2] From Board, dated 27th June, 1820.
To Board, dated 19th July, 1820.
From Board, dated 4th August, 1820.

Government forests.

The first notice[1] that I have been able to discover in regard to the reservation of forests for Government use alone occurs in 1826. The whole of the forests had always been recognised as belonging to Government, and any part of them could therefore be appropriated to the exclusive use of Government without the slightest infringement of the rights or claims of a single individual. Mr. Traill recommended the reservation of the *tháplas* or terrace land immediately adjoining the lower range for the timber and bambus required by Government, whilst the extensive forests below it should still remain open to private individuals. A proclamation was issued in 1826, prohibiting the cutting of *sál* within the reserves, which were at once excluded from the lease of forest produce, and thus the system of Government forests commenced. In 1828, as we have seen, the lease was fixed for four years, but in 1831-32 I find the total forest revenue amounted only to Rs. 4,328, of which Rs. 2,923 were realised in Kumaun and in 1832-33 it reached Rs. 4,457, of which Rs. 2,932 were collected in Kumaun. No attempt was made to enforce any system of conservancy and the old system of leasing out the forest dues to contractors continued. In the report on the settlement of Garhwál in 1840, Mr. Batten remarks that large portions of waste lands, including whole ranges and their vast forests, were included from olden time in the boundaries of the adjacent villages, though not in their recorded area. No change in this nominal allotment of waste was then attempted, as such a division was found useful in assigning separate tracts for pasture for the cattle of different villages; but, at the same time, the inhabitants of the villages within whose area these tracts of waste land were nominally included were prohibited from levying any grazing dues unless it had been a custom of immemorial date, and even then the burden of proof rested on those claiming the dues. A similar clause was entered in the lease given to the head-man and in the several agreements signed by the shareholders in the village. Mr. Batten further states that his report[2] should be considered, in a measure, declaratory of the principles on which the settlement was formed, and adds :—"I therefore take this opportunity of asserting that the right of Government to all the forests and waste lands not included in the assessable area of the estates remains wholly unaffected by the inclusion of certain tracts within the boundaries of villages, and no one has a right, merely on account of such inclusion, to demand payment for the use of pasture-grounds or for the permission to cut timber and firewood. Neither does such inclusion interfere necessarily with the right of Government to accept offers for clearance (*naudbad*) leases. But as ordered in the case of the Tarái forests, so in the hills (where, too, claims to proprietary rights are rare), the inhabitants of the villages most adjacent to the tract, or having it recorded within their boundary, should have the first refusal of such leases." In his Kumaun report Mr. Batten distinctly states that these principles apply equally to Kumaun.

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[1] To Board, dated 22nd June, 1826. To Collector, Bareilly, dated 20th September, 1826.

[2] Stat. Kumaun, 126, 330.

In his report on the Kumaun Bhábar in 1846-47 Mr. Batten gives the revenue from the *káth báns* and *chárái* máháls as follows :—

Name of patti.	Forest dues.	Pasturage dues.	Total.
	Rs.	Rs.	Rs.
Kota	4,600	3,801	8,401
Chhakháta	1,451	2,650	4,101
Káli Kumaun	3,705	2,522	6,227
Total ...	9,756	8,973	18,720

He states that though the injury said to be done to the reserved Government forests was somewhat exaggerated in some places, the Government rights had been suspended and in others the older trees had been removed, and recommended that steps should be taken to preserve the few patches of old *sál* that remained and the young *sisu* plantations. In the eastern Bhábar cultivators were allowed to clear the ground and sell the timber. The restriction as to cutting *sál* in the *tháplas* or plateaus of the lower hills which was issued in 1826 had been removed, when Mr. Traill saw the farms falling in one after the other owing to the scarcity of *sál* in the lower sites. In the Kota and Chhakáta Bhábar the farmers were allowed to cut down and sell the *sál* timber which is there confined to the *tháplas* and does not occur also in isolated patches in the plains as it does farther east. In appendix A. will be found a list of rates according to which farmers of the forest dues in Kumaun were authorised to collect from the exporters in 1847, and we shall now proceed to describe the forests as they now exist.

Sub-Himálayan forests.

The sub-Himálayan forests of the Kumaun and Garhwál districts extend from the Ganges to the Sárda, covering the lower spurs and ridges of the Himálaya and running down some distance into the Bhábar. The Tarái forests contain a little *sál*, of inferior growth, barely sufficient for the requirements of the cultivators, and are not included in the tracts under the Forest Department. With the exception of a portion of the Chándni Chauk which belongs to the Tarái, almost all the islands in the Sárda below Kumaun have been given to Nepál. A cart-road running along the foot of the hills from the Ganges to the Sárda generally forms the southern boundary of the forests in Garhwál, but further east several blocks reserved for Government purposes lie to the south of the road and are included in the existing reserved forest area. The western Rámganga and its tributaries, the Barsoti and Kotirao, form the boundary between the two great forest-divisions of Kumaun and Garhwál, whilst the outer Himálaya give a well-defined boundary on the north. Except the Kumaun Iron Company's grant and a number of villages, all of whose rights have been recorded and for whom blocks of forest have been left open, the entire area described forms one vast State forest in one compact block perfectly marked out either by natural or artificial boundaries. Within these limits no private rights exist which can prove injurious to the best *sál* forests, and cattle-grazing is prohibited in all portions which are free of village rights, except where it is entirely harmless. The most valuable timber is *sál*, which grows with great vigour in many parts and covers about one-fourth of the forest area. *Tún* (*Cedrela Toona*) and *sissoo* (*Dalbergia Sissu*) are plentiful in the low, moist valleys and flats, whilst other jungle trees, especially the Terminalias, Lagerstrœmias, Acacias, various species of Anogeissus, Adina, and Ougeinia, are found mixed with *sál* everywhere, even when the last predominates. Amongst the minor forest produce the bambu takes the first rank, and next the matting and cordage materials and indigenous drugs, tans and dyes.

We shall now proceed to give a short account of the existing forest-divisions and their origin. The contract arrangements for felling continued in Kumaun until the year 1858, and as a consequence no

Kumaun forest-division.

system of conservancy could be introduced. The forests of the present Kumaun forest-division[1] were denuded of good trees in all easily accessible places, and were it not that nature has happily made the *sál, sisu, khair, and dhauri* largely reproductive, the new Forest Department would have had little to conserve. Between 1855 and 1857, the demands of the railway authorities induced numerous speculators to enter into contracts for sleepers, and in order to secure a certain favourite area for themselves, these men were allowed, unchecked, to cut down acres of old trees very far in excess of what they could possibly export, so that for some years after the regular forest operations commenced the attention of the department was chiefly directed to cutting up and bringing to the depôt the dead timber left behind by the contractors.[2] Major (now General) Ramsay was the first Conservator. He abolished the contract system in 1858 and gradually introduced a better arrangement, by which the cultivation of patches of land in the forests proper was discouraged and the cultivators were induced to take up lands chiefly south of the cross-road from Hardwár to Barmdeo, leaving the valuable forest land to the north untouched. This the first attempt at real conservancy would, probably, have succeeded better had not the management of the forests been taken from the Commissioner of Kumaun in 1868, for arrangements of this kind take much time and trouble to elaborate. In his report for the year 1867 the Commissioner writes :—"As yet cattle have not in all cases been excluded from the tracts recently made over to the Forest Department, because some time must be allowed to the villagers to make other arrangements. A great many cattle-sheds have been removed from the vicinity of the *sál* forests of the outer range between Haldwáni and the Sárda river and the cross-road has been declared the boundary nearly the whole way." In his report for 1868 the Commissioner writes :—"In another year or two I hope that all the Kumaun valuable *sál* forests will be as free from cattle as those of Garhwál." Unfortunately this is hardly true even at the present day. The same officer introduced the system of having all trees marked by responsible officers before permission was given for felling and commenced arrangements for protecting the reserved forests from fire. Operations, however, appear to have been conducted on too large a scale or were too irksome to the squatters, for, though successful for a time, the occurrence of an unusually dry season led to great loss by fires. But, on the whole, the administration of the forests was a marked success. From the table given in the appendix the receipts and expenditure for the years 1859-60 to 1867-68 show an excess of receipts over charges amounting to considerably over fifteen lakhs of rupees.[1] The forests not only gave a better return but were conserved for the first time, and arrangements were made for the better protection of the young plantations and planting out the denuded tracts.

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[1] This division extends from the Sárda on the east to the Phíka river on the west and from the base of the outer hills on the north to the boundary of the Tarái district on the south. I am indebted for the materials for the notice of this division to Major Campbell through the Conservator, Mr. G. Greig.

[2] See Major Ramsay's report on the condition of the forests in 1861 in *North-Western Provinces Gazette* Supplement, 19th December, 1861

Under the Imperial Forest Department.

Major Pearson took charge of the Kumaun forest-division in 1868, but made little change in the working arrangements. In 1877 the reserved forests in the Kumaun Bhábar were formally demarcated,[2] and it will be convenient to adhere to the arrangements then sanctioned in the following brief description of each block :—

Block 1 comprises the Chilkiya forest, which is one of the largest and most valuable, having an area of about 126 square miles and containing much fine *sál* timber. The more accessible forests in this block were worked by contractors before 1858, and the remainder have furnished the chief part of the timber brought to market since that year. The entire block has been worked, but there are still numbers of mature trees that have been reserved for shade and shedding seed and which may be cut down when the young stock have been established. Fire conservancy has also been successfully enforced for some years and the young trees bid fair to produce good timber.

Block 2, comprising the Garhi Bálchand forest, has an area of 17 square miles, all of which have been demarcated, and of this about 11 square miles have been enclosed with fence and ditch and are protected from fire. The forest is chiefly *sál*, but the soil does not seem suited to produce large sound trees, and its fittest use will be to supply saplings, which can be carted from the spot and will find a ready market in the plains.

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[1] Receipts, Rs 32,90,459 (Kumaun, Rs 15,01,050, Garhwál, Rs 17,89,309). Charges, Rs. 17,43,542 (Kumaun, Rs. 8,33,477; Garhwál, Rs 9,10,065).

[2] See G.Os. No. 407 F.C., dated 5th September, 1877, and No. 173, dated 29th February, 1879.

Block 3 comprises the western Kota forest, which has an area of about 55 square miles and contains much valuable *sál* forest. General Ramsay writes :—"There is no part of Kumaun where *sál* thrives so well as in the Kota Dún, west of the Dhabka river." The Kota forests have been worked like block No. 1 and have supplied much timber to the market during the last twenty years. Fire conservancy has been introduced since 1877.

Block 4, comprising the forests below the Chhakháta parganah, has an area of about 103·5 square miles and consists of *sál* on the *thápłus* or plateaus and some very fine *haldu* below. The western portion between the Bhakra and the Gaula streams has been worked for many years by the Nawáb of Rámpur,[1] and the eastern portion from the Gaula to Chorgaliya by contractors and for canal-works and building purposes in Haldwáni. The only large tract remaining unworked in this block is the Nandhaur valley.

Block 5 is known as the Horai forest. It has an area of 14 square miles and lies below the hills. It contains some valuable *sál* forest, of which the eastern half has been enclosed with fence and ditch.

Block 6, or the Káli Kumaun forest, has an area of about 230·5 square miles and consists entirely of hill-forest, of which the lower slopes and more easily accessible parts have been worked out by contractors. Still there is a larger area of unworked *sál* forest here than in any other block of the Kumaun Bhábar.

Block 7, or the Dhyánirao forest, has an area of 68 square miles, of which about one-third is *sál* forest and the remainder is chiefly *khair* and mixed jungle and open plains, on which immense numbers of cattle graze.

Block 8, known as the Chola forest, has an area of about seven square miles, of which about a quarter is *sál* forest and the remainder is chiefly *haldu* and bambu.

Block 9 comprises the Barmdeo forest, which has an area of 7·3 square miles and lies at the foot of the hills near the Sárda river. It contains some promising young *sál* forests, besides *khair*, *sisu*, and bambus.

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[1] The Nawáb of Rámpur is allowed to export every year 200 trees, not less than 5½ feet in girth, free of duty.

Block 10, known as the Sárda forest, comprises a number of islands in the Sárda which are covered with *sisu* and *khair* forest and have an area of about eight square miles.

Block 11 comprises a small patch of *sál* forest on the Sárda about three miles above Banbasa measuring 320 acres, recently transferred to the Imperial Forest Department, which has charge of all these demarcated forest blocks, and the remainder of the forest area is managed by the Commissioner of Kumaun. As a rule, the good *sál* forests consist chiefly of *sál*, but there are also patches of *tún*, *khair*, *sisu*, *sándan*, *gosam*, *sain*, *haldu*, *dhauri*, *bákli*, and bambus, all of which are rising in value every year. The cart-road from Barmdeo to the Ganges is connected with cross-roads to the different blocks and temporary roads are made when necessary.

In the young forests the trees differ materially in different localities. In some places where the soil is suitable and other circumstances have favoured the growth of the young trees, they are exceedingly fine and show straight stems, clean barks, and fine heads. In other places where the soil is poor, but more especially where the numerous cattle stations formerly existed, and where in consequence the young trees suffered continually from being lopped, barked, and otherwise injured, and where they were more exposed to repeated fires, the trees are knotted, crooked, and with poor heads. The best forests in the eastern tract are perhaps those above Barmdeo, near the junction of the Ladhiya with the Sárda, where, owing to the favourable nature of the soil, the *sál* has developed to a remarkable degree and, owing to the difficulty of carriage, the trees have been left uninjured by speculators and contractors. Next in importance come those to the west and north of Chorgaliya and those on the flats and plateaus above the Jagbura and Kulauniya streams, and next the *sál* forests in the valleys of the Nandhaur and Sarúragadh streams. The geological formation in the last tract is sandstone and massive boulders. Further west there are still valuable forests between the Kosi and the Rámganga, and there can be little doubt that in the course of time the forests under a careful system of conservancy will renew their pristine vigour and well repay the care and money expended upon them.

Iron Company's forests.

The only important private forest is that belonging to the Kumaun Iron Company, whose grant extends from the Manár Gadhera, about one mile west of the Dhabka, as far as the Bhakra river, about half way between Káládhúngi and Haldwáni. The grant is bounded on the north by the Himálaya and on the south towards the Bhábar by a line of pillars, and the area is about 350 square miles. The collections from this tract for timber and minor forest produce from 1861 to 1881 have amounted to more than two lakhs of rupees, and it now constitutes one of the most valuable forests in Kumaun. It is difficult to say what portion of their rights Government resolved to grant to the company, for the deed was never executed, but from the draft it would appear that only fuel-rights were intended, and certainly none other is expressed. The subject of these forests and the company's claim to them being now under the consideration of Government, it will not be necessary to allude to them any further.[1]

Climate, &c.

The climate in some parts of the tract below the Kumaun hills is fair from November to June, but in other parts it is very fatal in November and after April. During the cold-weather the Bhábar forests present a busy scene. They are then filled with wood and bambu cutters, labourers hauling out timber, men and women collecting *bábar* grass, making mats and baskets, gathering roots, leaves and plants used in medicine or the arts, or herding cattle. After April all, except those who have become acclimatised, leave the forests, and during the rains they remain practically closed. Ordinarily every hill stream becomes then a raging torrent often impossible to cross for several days. Elephants and tigers, though now less numerous than in former times, return to the haunts from which they had been driven during the hot weather: the prairies become a sea of grass and the undergrowth in the thick jungle presents an obstacle to moving about most difficult to surmount. To the unacclimatised these forests are deadly during the rains, and few survive the malarious fever that a night's residence within them then frequently gives rise to. There is no doubt, however, that the clearances effected by the Bhábar cultivators have done much towards ameliorating the climate, for places where man could not formerly exist are now the centre of flourishing colonies, the inhabitants of which remain all the year round in their villages.

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[1] See for a sketch of the Company's history.

Naini Tál forest-division.

The forests in and around the settlement of Naini Tál were demarcated in 1865 and now form the Naini Tál forest-division.[1] Previous to 1845, all the trees in the neighbourhood were considered to belong to the villages within whose boundaries they were situate, and those within the valley were alone protected. Some years later, the Commissioner took over the forests in the neighbourhood of the settlement and allowed no timber to be felled without his permission. A small establishment was entertained to patrol the forests and a royalty was levied on each tree felled to meet the expense. In 1865, the forests were taken over by Government, and have since then been managed chiefly with a view to supply the local wants of Naini Tál. *Chír* of a good quality for building purposes is abundant and the various species of oak and the rhododendron afford materials for charcoal. In 1879, these forests were gazetted as 'protected,' and now comprise about 38 square miles. *Deodár* plantations have been made with marked success along the slopes of Lariya kánta, and *bánj* and *tilonj* and *kharsu* oaks, also walnuts, horse-chestnuts, and ash have been extensively sown and planted. An attempt to reproduce the cypress was thought to have failed, but the seeds have germinated after remaining a long time in the ground.

Ránikhet forest-division.

The Ránikhet forest-division is, like the preceding, intended to control and provide for the local supply of timber and fuel to the Ránikhet settlement. The Imperial Forest Department deputed an officer to take charge of the forests around the intended military station in 1867, but it was not until 1873 that the forest boundaries were finally settled and operations regularly commenced. The tracts now conserved[2] are fifteen in number, of which one having an area of about seven square miles is closed and surrounded by a ring fence of thorn and is 'reserved' and clear of all private rights. It contains pine, oak, rhododendron, and other woods of minor value. The other forests which are 'protected' and cover an area of about 59 square miles are *situated at distances varying from one to 24 miles from Ráni*khet, and are held conjointly by Government and the inhabitants of the villages within whose area they occur. The latter have a right to graze their cattle and cut wood for fuel or for building or agricultural purposes, but no power to cut for sale to any one. But the great feature of this division is the nursery which, though commenced only in 1871, has done much good in distributing[1] fruit and timber trees all over the province and in conducting acclimatisation experiments.

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[1] Reserved by Nos. 149 and 150, dated 21st February, 1879.

[2] See G. Os. Nos. 176 and 177, dated 26th February, 1879.

Garhwál forest-division.

In Garhwál, as in Kumaun, the contract system remained in force and, in 1839, we find the right of collecting the forest and pasturage dues of the Pátli Dún leased to one Padam Singh for twenty years at a fixed annual rental of Rs. 2,750, of which Rs. 1,649 were on account of the *káth-báns* section. The forests here are amongst the most valuable both for timber and bambus that exist along the whole line of hills between the Jumna and the Sárda, and the loss that must accrue should this arrangement continue was brought[2] to the notice of Government in 1853. The result of the correspondence that then took place was that Padam Singh's rights were purchased for Rs. 15,000, and the forests were taken under direct management and transferred from the Bijnor district[3] to Garhwál, whilst the collection of the dues from the Khoh river westward still remained with the plains authorities. Posts were established at the outlets of the Kotri and Pátli Dúns for the collection of dues from exporters, and the surplus revenue was devoted to opening up roads and improving the forests. In 1854, Captain Reid took over the management and remained in charge until 1858. Captain Reid attempted little in the way of conservancy, but commenced felling operations on a large scale and erected a saw-mill that could not be worked owing to a defect in the slope of the canal that was to afford the motive power. The mutiny then intervened, and in 1858 the forests came under Major Ramsay, who introduced the system of conservancy that we have noticed in the account of the Kumaun forest-division. His administration was marked by the control of felling operations, the removal of squatters from the valuable forest tracts to available land fit for cultivation below the forest boundaries, the construction of roads and the establishment of stations for the collection of revenue at convenient intervals. In 1861-62, cultivation in the Pátli Dún was put a stop to by assigning lands to the people in the Bhábar, and the cattle-stations were broken up and removed from the reserved forests. This operation occupied three years, from 1862 to 1865, the cattle stations being removed from all the Garhwál forests, and in Kumaun from all the forests above the main line of road. In the meanwhile excellent roads were opened out, and the forests, especially those of Garhwál, were made accessible from all sides: at the same time a regular system was instituted of working only certain forests, the remaining ones being kept rigidly shut up, and the selection and marking of all trees previous to felling was insisted on. The felled timber left by the old contractors and Captain Reid was exported and sold and the machinery of the saw-mill was transferred to Rúrki. Colonel Baugh acted as Conservator under Major Ramsay and an establishment was entertained to prevent the felling of timber without license, to protect the forests from fire, to cut down creepers and to mark trees for felling. The management of the forests was transferred to the Imperial Forest Department in 1868, and, in 1879, the whole forest-division of Garhwál from the Rámganga to the Ganges was divided[1] into five blocks, an arrangement that we shall observe in the following brief description :—

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[1] 12,000 grafted plants have been distributed to villagers and householders, besides some 32,000 forest and ornamental plants, and about 400,000 forest trees have been planted in the reserve from the nursery.

[2] By Mr. (now Sir John) Strachey, to Commissioner, 4th August, 1853; from Government, No. 3747, dated 17th September, 1853

[3] The collections of the forest and pasturage dues from the Kotri Dún, including Udepur, was handed over to the Superintendent of the Dún and the Collector of Bijnor in 1840. In 1859, the dues from the Kotri Dún and the Rawásanwár part of Udepur amounted to Rs. 1,403, and from the Rawásan-pár portion to Rs. 1,011 a year; total of Garhwál, Rs. 5,164.

Block 1 comprises the Pátli Dún forest with an area of 237·5 square miles. It is bounded on the east by the Kumaun boundary and on the west by the Paláin river to its junction with the Rámganga, and thence down by the Rámganga to the Bijnor district.

Block 2 comprises the forests of the Kotri Dún with an area of about 180 square miles, and is bounded on the east by the Pátli

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[1] F. 162, dated 24th February, 1879.

Dún forests and on the west by the Khoh river to the Kotdwára mart, thence by Jamangarh and the Lálpáni ridge to the Saneh depôt on the Ganges road.

Block 3, known as the Saneh forest, has an area of 17 square miles and lies between the Khoh river on the east and the Málin river on the west as far as the Chaukighâta mart.

Block 4, known as the Láldháng forest, has an area of 36·5 square miles and lies between the Málin on the east and the Rawásan river on the west.

Block 5, comprising the tract between the Rawásan and the Ganges known as the Khára forest, has an area of 88 square miles.

Block 6, known as the Kartiya forest, has an area of about 800 acres. It consists chiefly of *sál* and is situate on the left bank of the Mandhál stream.

The northern boundary of all these blocks lies between the cultivated area of the hill villages and the forests proper, and the southern boundary is found in the road between Kotirao on the east and the Ganges on the west.

Pátli Dun forests.

The Pátli Dún forests occupy the valleys of the Rámganga and its affluents and the ridges which run between their watersheds. The geological formation of this tract consists of alluvial deposits and drift in the valleys and plateaus, and massive grey sandstone interspersed with blue shale on the ridges. The whole Dún has been a noble forest of *sál*, the lower and more accessible portions of which have been worked out, but in which enormous tracts of virgin forest still remain, from which under judicious treatment inexhaustible stores of timber may be drawn. Excellent roads were constructed though the principal valleys by Major Ramsay, and these have been kept up by his successors. The forests of this tract may be conveniently divided into those (1) of the Paláin or Taimúriya; (2) those of the Mandhál; and (3) those of the Rámganga, south Pátli Dún and Sona river.

(1) The whole basin of the Taimúriya and its affluents contains a noble *sál* forest. This tract was considerably thinned out many years ago for wood for the gun-carriage agency, but not to a too great extent, as the result has been satisfactory in the

improvement of the growth of second-class trees as compared with the condition of the same class of trees in those portions of the forest which have never been overworked. Throughout this tract since conservation has been enforced the growth of *sál* saplings gives hope of an unlimited supply of this valuable timber. This growth is fostered by the ground becoming thickly clothed everywhere with bambus, by which the moisture is retained in the soil and the increase of other grasses is prevented, and thus the risk of fires is materially diminished.

(2) The forests of the Mandhál owing to their remote position have never been much worked. There are here in consequence to be found a large number of first-class *sál* trees as well as an abundance of trees of every age and size. The good forests may be said to extend over about fifteen miles in length through all the lower portions of the valley below Jarat, on the slopes and plateaus facing the north and on the opposite bank of the Mandhál over the last five miles. On the plateaus above the river the *sál* has attained a very large size and fine *tún* trees exist in the valley which seems particularly well adapted to their growth.

(3). The forests of the valley of the Rámganga, the south Pátli Dún and the Sona are all situated on the hills sloping down to the Rámganga and its affluents, the Sona and Gaujhera nala on the right bank and the Maira Sot, Patharpáni and Dharau streams on the left bank. These forests were 'felled even to desolation' years ago and many parts of them have been permanently injured. No attempts at reproduction were made, and the land where fine *sál* forest once stood is now too denuded by exposure to admit of efforts in this direction proving successful. There are, however, some good young plantations springing up and some mature trees, as already noticed, exist in the Mandhál valley. The exceptions are places where the old trees have been completely cut away, and here, there being no natural shade or seed-sowing, the dense grass effectually prevents all artificially sown seeds from germinating, and though measures have been taken from time to time to reproduce the forest, they have met with only very partial success. There is still, however, some *sál* in the highlands, some *sisu* along the rivers and *tún* in the valleys, and a fair amount of *khair* and good grass in the open level ground. Below the Siwáliks there are great bambu forests on the level flats that afford a considerable revenue. The great question of fire conservancy has always engaged the attention of the establishment, and up to 1879 no great injury had been done for several years. In 1879, however, the cholera-stricken pilgrims returning from the Hardwár fair spread fires in every direction, and considerable damage to the young plantations resulted. Roads have been opened to all the principal blocks in connection with the road from Kotirao to the Ganges that forms the southern boundary of the division.

Kotri Dún.

The forests of the Kotri Dún lie between the Pátli Dún on the east and the Khoh river on the west. The formation of the soil is sandstone and drift and there is little water and few good forests. The trees are almost entirely *sál* differing in value in different places according to the soil and other natural circumstances. Few tracts in this forest have not been worked more or less, but there still remains some good timber on the more inaccessible ridges. Since this forest has been rigidly protected the young trees have made considerable progress, and the keeping out of cattle and fires will in a few years do much to restore them to their original condition.

Blocks 3 and 4.

Blocks 3 and 4 lie between the Rawásan and the Khoh rivers, a distance of about sixteen miles. The soil is a dry sandy loam with outcrops of gravel and blue clayey slate in the hills. The entire tract appears to have been extensively cultivated in former times, but there is a great want of water through all the lower forests. There are here three large *sál* patches. The first along the Rawásan has been extensively worked and little valuable timber remains; the second along the Chaukighála stream contains some mature *sál* trees and in the valleys *tún;* and the third is a young *sál* forest in the south-east corner of the division, about three square miles in extent. *Bahera*, *sain*, and *haldu* are also found on the lower plains along the southern boundary, but bambus, which grow luxuriantly everywhere, form the main article of export from both blocks.

Dehra Dun forests.

The early history of the forests of Dehra Dún has much in common with that of the eastern forests in Kumaun and Garhwál. Both the Garhwál

Rájas and the Gorkháli Government derived a considerable revenue from the various items of forest produce grown in the Dún and adjacent hills. This was usually levied as a *transit duty* and was collected with the export and import duties on every article of commerce entering or leaving the Dún. The aggregate amount of these duties in 1809-10 was Rs. 16,000, and in the following year was Rs. 15,200, of which over one-third was absorbed in paying the collecting establishment. The transit duties were abolished at the conquest, and with them the duty on the export of forest produce, which, though a legitimate source of income, was lost sight of until Mr. Moore took it under his management in 1819. For three years the duties on exports yielded a revenue averaging Rs. 4,000 per annum, and in 1822 were leased to one Surjan Negi for four years at Rs. 5,000 a year. In 1825, Mr. Shore gave new leases for five years to various persons for all the collecting stations, except that at the Kheri pass, at an aggregate demand of Rs. 8,500. In making these arrangements it was distinctly laid down that these dues were not to be regarded as transit duties, but as rent for the use of the forests and as a royalty on their products, and on this principle all subsequent settlements were made.[1] Curious to say, Mr. Shore[2] was averse to preserving *sál* and devoted all his attention to the propagation of *sisu*, going so far as to import seed for this purpose from *Fatehgarh*. *It does not appear that any attempt was* ever made to conserve the forests on any system or to control felling operations, and in 1829 the revenue had fallen off so much that balances amounting to Rs. 6,000 had to be written off on account of the leases granted in 1825. Major Young then took charge of the forests and offered the right of levying the forest duties to public competition by auction. The experiment was fully justified by the results, giving a revenue of Rs. 6,425 for the *gháts* on the Jumna and Ganges and of Rs. 9,595 for the passes to the plains, or a total of Rs. 16,020. The duties were farmed at these rates for the years 1830-31 to 1832-33, when another auction sale gave an income for three years longer of Rs. 25,345 a year. From 1839 to 1844 the farm was leased to Atmagír, a Mahant of Hardwár, for Rs. 35,000 a year, and at the conclusion of his lease the forests were taken under direct management by Mr. Vansittart and so remained until 1855, when a forest establishment was formed. A sál log which would then fetch at Meerut between forty and fifty rupees and could be carried on a four-bullock cart paid an export duty of only eight annas. Five of these carts could carry out one hundred maunds of good lime worth over Rs. 100, the duty on which was only twenty annas. A four-bullock cart of catechu sold for Rs. 200 in the plains, and a similar load of bambus (about 400) was worth eighteen rupees. It can therefore be readily understood how eager speculators were to enter into this profitable business, especially as no control whatever was exercised over their operations either as to the quantity of timber cut down or the localities to be worked. Mr. Williams writes:—"Every one continued to hack and hew away at the trees as he pleased, only paying certain dues to the farmer in the event of the wood being exported. The latter made his own arrangements to secure the collections at the different passes. Reckless waste was inevitable and the fine *sál* forests began to disappear rapidly. The absence of conservancy was absolute. The district still abounded in fine trees from one hundred to two hundred years old and upwards. All these fell before the axe, and probably the rest would have gone with them had the roads been a little better. The consequences of this bad system are most perceptible in the western Dún;" whilst in the eastern Dún large numbers of *khair* trees were cut down to burn lime for the Rúrki workshops and the canal head at Mayapur.

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[1] *To Commissioner*, Kumaun, 15th September, 1826.

[2] In appendix A,2 will be found a list of the rates authorised for collection by Mr. Shore.

With the introduction of a regular forest establishment in 1855 the revenue rose enormously, but unfortunately even then no system of conservancy was attempted. The mutiny intervened and in 1860 the revenue began to fall, and in 1867-78 reached the low figure of Rs. 23,332. In 1864, regular forest operations commenced under Mr. F. Williams, C.S.I., Commissioner of the Meerut division, within which the Dehra district is situate. His jurisdiction extended over the whole of the Dún forests, the Siwáliks and a portion of the Saháranpur district, besides certain forests of the outer range leased from the Rája of Tirhi. The story of the sub-Siwálik forests in the Saháranpur district has been noticed in the Memoir of of that district. No attempt of any kind was made to preserve the forests there; on the other hand efforts were directed to induce squatters to take up the land and clear it for agricultural purposes, and grants of so-called waste land were made to any one that could be prevailed on to accept them. Up to 1839 the forests were left entirely in the hands of the Rajpút zamindárs within whose boundaries they were nominally included, but in that year some 142,420 acres were demarcated as forest under the names Kheri, Kánsrao, and Pathari Nadi. Within these boundaries the grants were made and the tracts unlet were handed over to the new Forest Department in 1864. Mr. Williams devoted his attention to a survey of the forests, to making roads and securing and defining the rights of Government and individuals. This was no easy task owing to the neglect of former years which permitted the growth of prescriptive rights by lapse of time. It was not until 1877 that the forests were properly demarcated,[1] and we shall follow the arrangements then made in our brief description of the existing forest sub-divisions.

Existing forest-divisions.

Block 1, called the Siwálik range, is bounded on the west by the Jumna and on all other sides by a forest line marked by pillars. It has an area of 449·12 square miles and contains *sál*, *sain*, and *chír*. The two former are the prevailing trees, but are all young, and the last occurs along the slopes of the hills and on the higher peaks. There is a considerable export of bambus and the range affords pasturage for numerous herds of cattle. Block 2, known as Majhera, lies in the Rúrki parganah and consists of islands in the Ganges well stocked with *sisu* and *khair*. The area is only 6·74 square miles. In the western Dún we have block 3, known as Rámpur Mandi on the Jumna, devoid of trees and only yielding a revenue from grazing dues and grass. It has an area of only 1·54 square miles. East of this comes block 4, comprising the *sál* forest of Ambári and having an area of 6·4 square miles. The *sál* here is immature and is mixed with *sain*, *bákli*, and inferior forest trees.

Block 5, or Chándpur, has an area of 3·38 square miles and contains *sál* mixed with a few *tún*, *sain*, and *bákli* trees.

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[1] The following references are to the notifications of Government demarcating and reserving the forest lands :—73, dated 15th March, 1877 (all the Dún): 74, of same date (closes Tháno and Balawála): 443 dated 24th September, 1877 (reserves the eastern Dún): 190, dated 19th July (reserves the Pathari forests): 184, dated 27th February, 1879 (reserves all the forests).

Block 6, or Dholkot, has an area of 7·91 square miles and consists of *sál* with an admixture of *sain*, *dhaura*, and a few *tún* trees, but none are mature.

Block 7 comprises the *sál* forest of Tháno in the eastern Dún and has an area of 9·96 square miles. There are no mature trees, but there is a very promising crop of *sál* interspersed with *bákli*, *haldu*, *semla*, *sisu*, and *khair*. Baluwála and Tháno have been closed since 1877.

Block 8, or Nágsidh, has an area of 25·38 square miles consisting of *sál*, *sain*, *bákli*, and *haldu*.

Block 9, or Tirsál, is situate near Rikhikes and has an area of 28·22 square miles. All the mature trees have disappeared and only young *sál* remains, intermixed with *dháman*, *haldu*, *sain*, *jáman*, and *khair*.

Block 12, or Saora Saroli, comprises a small patch of *semlá*, *bákli* and *dháman* near Raipur, with an area of only 1·82 square miles.

Block 13, or the Song forest, consists mainly of *khair* trees and grass.

Block 14 comprises the Patri or Pathari forests in pargana Jawálapur of the Sahâranpur district and contains mainly *dhák* and grass appropriated for the use of the Rúrki workshops. Attempts are, however, being made to introduce timber trees, with what success is not yet apparent.

Ganges (Bhágirathi) division.

The Bhágirathi or as it is now called the Ganges division comprises the forests on either bank of the river of that name in the Rája of Tihri's territories. These were leased by Mr. Wilson from the Rája of Tihri in 1859, and in 1864 the lease was transferred to Government for twenty years. About one-third of the drainage area of the Bhágirathi and its feeders is covered with forest and cultivation, of which the forest occupies about one-tenth, or on a rough estimate 600 square miles.[1] From the village of Jhala, close to the point where the Bhágirathi cut its way through the snowy range, to Gangotri, the valley lies nearly due east and west for a length of about seventeen miles and is filled with *deodár*. For a few miles above Gangotri *deodár* is also found, but stunted and of little value. The excelsa pine also extends eight miles up the valley above Gangotri, and the birch is found in patches to within half a mile of the glacier. The forest on both sides of the river is divided into blocks, each of which has been roughly surveyed, giving some 12,500 acres of *deodár* and a fair average of second class, third class and fourth class trees. Before taking over the forests they had been much neglected and injured. "The ravages committed by the cultivators in the western portion of the valley, where thousands of dead trees, all killed by fire, disfigured the hill-side in every direction, were only equalled by the destruction committed by avalanches higher up the valley." The former practice has been stopped, but the latter influence continues, and the damage wrought by the cyclone of 1880 will be visible for many years to come.

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[1] See report by Major Pearson, Sel. Rec., N. W. P. (2nd Ser.), II., 117, and III.

Great forests of *Quercus dilatata* occupy the ridges between Masúri and the Bhágirathi, and noble forests of *chír* extend from Sainsa, some twenty miles above Tihri, as far as Bhatwári, a distance of about fifty-five miles along the valley. The latter tree clothes the mountains on both sides of the river and its affluents up to 3-5,000 above their beds, filling every ravine and occupying every plateau. Above Bhatwári the forests of box, yew, and cypress commence and cover the hills on both sides of the river as far as Jhala, a distance of about thirty miles, and from Jhala to Gangotri, as we have seen, the *deodár* is the principal forest tree. On the right bank of the river above Jhala, where it has a southern aspect, the forest is nearly pure *deodár*, but on the left bank, with a northern aspect, there is a large admixture of silver-fir, spruce, and birch. Up to Daráli the *deodár* extends to about a thousand feet above the river's banks, but further north it rises to fully two thousand feet, where it meets the vast forests of spruce and silver-fir already mentioned. The valley of the Jádh-ganga is also full of *deodár*, and towards its head the valuable pencil-cedar occurs in appreciable quantities. As a rule the growth of the *deodár*, except in very favourable localities, is much slower here than in the comparatively warmer valleys of Jaunsár. From an examination of the stumps of many trees it was found that a diameter of 16 inches was attained in 64 years, of 24 inches in 105 years, and of 30 inches in 230 years; the nearer the northern limit, the slower the growth. To recapitulate, the forests in the lower parts consist chiefly of pine. Higher up we have the yew, box, birch, three species of oak, two of juniper, cypress, silver-fir, spruce, *deodár*, and excelsa pine, and in small quantities the sycamore, horse-chestnut, and walnut. Only those useful timbers found in the more accessible valleys bordering on the Ganges below Deoprayág and between the Hiunalgadh and the Dún have hitherto been exported, and the revenue collected has chiefly been from *deodár* sleepers and small logs for building purposes and bambus.

Forests at the head of the Jumna and Tons.

The lease from the Raja of Tihri includes the forests in the remaining portion of his territories about the heads of the Tons and Jumna rivers.[1] These lie to the south and west of the Bhágirathi sub-division and may be noticed in order from the Bhágirathi westwards. There are the remains of a considerable forest of *deodár* above Bárahát near Salda and Uparikot in the Bhágirathi valley, and above it a splendid strip of *moru* oak (*Q. dilatata*). Crossing the water-parting into the Jumna valley, there is a small *deodár* forest above Shalna and small patches of the same tree about the Bouk and Nágtiba peaks, whence there is water carriage by the Jumna to the Dún. Crossing the Jumna to the Kedár-kánta ridge which separates the Jumna from the Tons, there are the remains of what was once a very fine *deodár* forest in the valley of the Banál, a tributary of the Jumna that joins it just above Barkot. There are also small patches of *deodár* in the Rámasera valley to the south of the Banál, but of no great value. The chief glory of the Jumna is, however, the immense forests of the long-leaved pine (*chír*) that line its banks and in which there are numbers of magnificent trees fit for any purpose. Unfortunately, sleepers of pine are not esteemed by railway contractors, being liable to dry-rot and requiring frequent renewal, and no means for effectually preserving them have yet been discovered. The left bank of the Tons is also covered with immense forests of *chír*. On the upper part of this river near Datmor, the *chíl* (*P. excelsa*) takes the place of the *chír* (*P. longifolia*). When the range that separates the Tons from the Pábar is crossed, we come again into a tract of which the characteristic forest tree is *deodár*. The *deodár* commences on the north of the Tons near Gangor, and is scattered all over the ridge that separates the Tons proper from the Panch-ganga river which joins the Tons opposite Shankuri. The hills here are rocky and precipitous, and the *deodár* is chiefly confined to the small ravines and streams that run down from them to the river. The more important forest lies between Gangor and Datmer and on the further side of the ridge above Lyor and opposite Kahsol and Raksha.

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[1] Sel. Rec., N.-W. P., III, (2nd Ser.,) 120.

Following the course of the Tons southwards, we find a considerable amount of *deodár* on the spur that comes down to the river a little above the village of Koarbo, also in the valley of the stream next to it on the west. The Rupin joins the Tons on its right bank at Naintwári, and on both its own banks and on those of its feeders are large and valuable forests, the lower part of which consists of *deodár* and the upper part of excelsa pine and silver fir. The valley of the next tributary of the Tons on its right bank also contains a very large proportion of *deodár* forest interspersed in places with silver fir, spruce, and oak. If we take the country from the junction of the Rupin and the Tons as far as the junction of the Tons and the Pábar, some of the finest *deodár* forests in the hills may be met with; and here the Forest Department found a valuable addition to their resources for meeting the demands for sleepers. In 1869, the forests of the upper Tons were estimated to contain 50,000 *deodár* trees fit for felling and to be able to supply a lakh of sleepers per annum, but no such great demand has yet been made on their resources. It is the Jaunsár-Báwar and Bhágirathi divisions that have had to provide the largest number of sleepers in recent years. *In the year 1879, the forests on the upper Tons with* those in khats Deogarh and Báwar of Jaunsár-Báwar were formed into a new division known as the Tons division.

The forests of the Jaunsár division now comprise the whole of Jaunsár-Báwar except khats Deogarh and Báwar to the north of the Dharmigádh and Banál, Shalna and Jaunpur in Tihri. They had little or no practical value in the earlier days of British rule, owing to their distance from the plains. With the denudation of the Dún, however, their real value became known, and some rough attempts at management were undertaken. Up to the year 1868, the Commissioner of the Meerut division was *ex officio* Conservator of the Jaunsár-Báwar forests, and when the latter came into the hands of the Forest

Jaunsár-Báwar.

Department, everything connected with conservancy had to be taken in hand. Here, as in the eastern hills, the people, though nominally in possession of immense tracts of forest land, were never considered proprietors, but occupiers entitled to the usufruct and whose rights were sufficient to prevent people from other *khats*—as the local subdivisions of the district are here called—from entering upon or using the nominal waste in their possession. They could pasture their cattle in every part of this nominal area and cut down trees for fuel or for building or other agricultural purposes, but could not alienate these rights to others. The Dún forests were being worked out whilst the demand for sleepers for the railways was increasing every year, so that it became necessary for the authorities to examine closely their timber resources, so as to meet the wants of both the Government and private persons, present and prospective. It had been shown that permission to graze cattle in a forest was absolutely incompatible with forest conservancy. Provision had also to be made for stopping the destructive fires that, hitherto, regularly swept away every year the young trees that a suitable soil and climate had raised to fill up the gaps caused by felling. The people were accustomed to obtain early grass in the hot weather by setting on fire the old grass, provided rain fell at the right time. This is the chief reason given for their adherence to this practice, but it has been shown that the rank crop of grass that occurs after firing is much coarser and less nutritious than if nature had been allowed to deal with the reproduction of the plant in its own way. Each one, too, imagined that he had a prescriptive right to hack and hew when and where he desired. The weak establishment hitherto kept up was insufficient to control the felling of timber, and it was not uncommon for a Jaunsári, who wanted one tree to repair his homestead, to cut down eight or ten and sell the surplus. To remedy these evils, the forests had to be demarcated, then grazing and the felling of timber in unauthorised places had to be restricted, and, again, fire conservancy had to be introduced. To prevent unlawful felling in the demarcated tracts an officer was usually deputed to inspect the work before a pass was given to fell trees. The people objected to this, as it gave them trouble, caused delay, and cut off one source of their irregular gains; so that in a short time a great cry was raised against the demarcation of the waste lands as

Government property. As already noticed, at the former settlement, the right of each *khat* in the lands within its own boundary was declared absolute as against all other *khats;* the use of the wood and jungle products was allowed to them, but it was held that they had no right as against Government—*i. e.*, Government could at any time step in and appropriate any portion required for its own use or for settlement with others, so long as sufficient lands were left for grazing purposes to each village. Since that time circumstances have greatly changed and almost every considerable tract containing forest useful for timber or fuel has been appropriated and marked off as first or second class forest. A large area has been taken possession of at Chakráta, sufficient for all the requirements, present and prospective, of the cantonment there. What remains is good for grazing or for grass and jungle produce or possibly for some extension of cultivation. It is good for little else, and there is no prospect of its being turned to any other account. There is probably no portion of this land that can be used either for tea cultivation or for any kind of plantation. Under these circumstances the question arose whether the restriction as to proprietary right being acknowledged in anything more than the cultivated and occupied spots should be maintained. Sir W. Muir resolved[1] that only such waste lands in excess of the requirements of a *khat* should be marked off as "Government waste" that were in excess of one thousand acres. That within the *khat* proprietary right should be exercised over all third-class forest land to such extent as each *khat* might require, with the provision that had always existed that there should be no power to alienate the lands. The restrictions as to grazing and collecting firewood were confined to first-class reseved forests. Such concessions as were then granted and such restrictions as were then enforced were entered in the *wájib-ul-arz* or 'record-of-rights' of each village, so as to prevent any disputes in future.

The Jaunsár division is entirely surrounded by Native States, except on its southern boundary, where it adjoins the Dehra Dún. The main physical feature is the great central ridge that forms the water-parting between the Jumna and the Tons. Commencing at Haripur-Biás near Kálsi, it runs west of Chakráta to Deoban, and then in a north-easterly direction to the Karámba peak. It next turns round the head-waters of the Dháragádh and proceeds eastwards into Tihri. It is along this ridge and its numerous spurs that the chief forests are found. The rocks are principally limestones, shales and slates. The first-class forests within this tract measure 8,795 acres, and the second-class forests cover 88,282 acres. The first-class forests are entirely within the control of the Forest Department with the exception of some 575 acres, within which grazing rights are permitted. Of the second-class forests some 13,917 acres are temporarily closed and are preserved from fire to allow of reproduction. The division forms a section of the outer Himálaya and the forest vegetation varies accordingly. At Kálsi on the south we have such trees as *sál*, *bákli*, *dhaora*, *kúsum*, *haldu*, *khair*, and *sisu*, some of which run a long way up in the hot and confined valleys of the Tons and Jumna to an elevation of nearly 4,000 feet. We have next the grey oak, rhododendron, and *Andromeda* between 5,000 and 7,500 feet. At the lower limit we have the *chír* pine and at the upper the blue-pine and the *deodár*. Above these, 7,500-10,000 feet, come the *deodár*, *moru* and *karshu* oaks, four species of maple, horse-chestnut, walnut, cypress, spruce and silver fir, yew and several species of *Pyrus* and the willow. Of all these, the *deodár* is the most valuable, and it is now found in the Lohkandi and Kotikanásar forests in khat Misán; the Konain forest in khat Lakhan; the Tutwa, Maura and Lakhan forests on the Dháragádh; the Chijál or Kathiyán forest in khat Phanyár, and the Koti forest in Báwar. Of these the Lakhan forest is the finest, but it is doubtful whether the Dháragádh can be utilized for the transport of timber. The revenue and exports of timber will be found in the appendix.

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[1] G. O. No. 30A., Revenue Department, dated 4th January, 1873.

Forests of the Upper Himálaya in British territory.

The forests of the Upper Himálaya in Kumaun and British Garhwál contain very little *deodár* and are composed principally of *chír* pine, spruce, silver-fir, oaks, horse-chestnut, and other trees of small economical value, and consequently, except those on the upper feeders of the Alaknanda,[1] have hitherto been little worked. From these latter a large number of *chír* sleepers has been supplied to the East Indian Railway. There are several fine forests of *Abies Smithiana, A. Webbiana* and *Pinus excelsa* along the left bank of the Alaknanda from Joshimath to Pipalkoti, but they occupy the tops of the ridges at some distance from the river. The long-leaved pine covers the slopes of the Nagoli valley opposite Nandprayág, the Nágpur hills opposite Chhatwapípal, and the valley up to Pokhri. The forests on the upper part of the Mandákini and in the valley of the Madmaheshwar rivers are too distant to be of economical value. Similarly, the fine *chír* on the slopes of Tungnáth are too far from the river to bear the expense of export, though, perhaps, the box-wood, of which there are some good examples, may prove of use. The cypress and excelsa forest on the Bishunganga near Badrináth is also too far removed from the means of carriage to be suitable for working. The pine forests near Tapuban on the Dhauli are the most extensive in Garhwál. They stretch in one unbroken block from the western spurs of the Pilkhúnta range to above Rindi, a distance of sixteen miles with a breadth of from one to three miles. All this is a mixed forest of *Abies Webbiana, A. Smithiana, P. excelsa*, cypress and a few *deodár*, with box, yew, and *Quercus semecarpifolia.* The sycamore (*Acer pictum*, Thunb.), from which the Tibetan bowls known as *lahauri-doba* are made, is found in the valley of the Ríniganga with horse-chestnut (*Æsculus indica*) and silver fir. Higher up the Dhauli as far as Malári similar forests occur, and here also is the only natural *deodár* forest in British Garhwál, but unfortunately so placed as to be useless for export.

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[1] See Webber's forest survey of Kumaun and Garhwál, 1864-65, which gives colored maps on the scale of one mile to an inch in sheets of twelve inches square, accompanied by tabular statements showing the acreage and number and class of trees in each block.

Northern Garhwál.

Southern Garhwál.

In Southern Garhwál, there are *chír* forests on the Nayár at Kainúr, Sungarkhál, and Juniyagarh, and on the Dúdúkatoli range, great forests of silver fir and spruce cover all the summits up to 8,000 feet. The western slopes of the same and adjoining ranges are clothed with dense forests of oak and other trees of some value to the extent of about fifty square miles, of which the silver fir occupies eleven square miles. Below Kainúr, the Nayár might be used for transporting small timber during the floods, but the Chhíphalgháti river is too shallow for this purpose and too much obstructed by boulders, though fine *chír* trees are to be found on both its banks and at Saimkhet and Tál. The Dhanpur hills have been cleared of jungle for the mineral works. The eastern slopes of the Dúdúkatoli range are covered with oaks and some seven square miles of silver fir and they drain down to the Rámganga. A fine *chír* forest nearly fifty square miles in extent occupies the valleys leading to the Rámganga between Lohba and Ganái, and the pine-clad slopes of Badhángarh and Bhatkot have a similar direction. The Rámganga appears to be large enough for floating down sleepers during the time of flood, and these forests may prove a useful reserve hereafter. All the hills below Ganái are covered with stunted and twisted *chír*. Extensive *chír* forests of good quality exist at Ránikhet and Syúni, and have already been noticed: also along the Gágar range and in the Malwa Tál, Rámgarh, Saiunkhet, and Khairna valleys, and at Badhándhúra on the Kosi. The Kosi appears to be unfit for rafting except in the floods, when small timber might be sent down it to Rámnagar.

North-eastern Garhwál.

The pine forests on the Pindar from Betuwa to Kulsári adjoin the river where it is 3-600 feet wide. From May to October, the floods are incessant and sufficient to float the largest timber to the Alaknanda at Karnprayág, and thence to the Ganges at Hardwár. There are no rocks, rapids or obstructions the whole way, and the fall is about fifty feet to the mile. The cost of felling is about two annas per tree, and the cost of carrying and shooting down large trunks would be from two to five rupees each according to the distance or, if previously cut into sleepers, about one anna per sleeper per mile of land carriage. Sawing can easily be arranged for by imported labour. For three or four miles above its junction with the Pindar, the Kailganga might be used for sending down small scantlings of the pine which grows abundantly along its banks, but the cypress appears to be too far up to admit of working. The Nandákini, for the first fifteen miles from its junction with the Alaknanda, possesses sufficient volume in times of flood for the transport of sleepers from the magnificent forests along its banks. The extent and variety of the pines here are nowhere surpassed. They grow over the entire valley, six different species being indigenous and a diameter of five feet is a usual size. The spruce forest above Kanáli is the most important, but cypress and *deodár* also occur with yew, hazel, box, and all the other pines except *Abies dumosa.*

Northern Kumaun

The upper valleys of the Sarju and its tributaries contain over a hundred square miles of fine pine forest. About and above Kapkot there is nothing but pine; much of it, however, is practically inaccessible, and as the Sarju is not a snow-fed stream, rafting can only take place in time of occasional floods in the rains. The valley of the eastern Rámganga down to its junction with the Sarju has a considerable extent of *chír* and silver-fir forest along its banks, but the river itself presents some obstacles to rafting. *Sál* also occurs in the valleys of the Sarju and Rámganga, but of little value as timber. There is a considerable amount of pine forest near enough to the Káli, and about Askot and Balwakot some very fine timber. Indeed, almost all the valleys leading down to the Káli between Askot and Barmdeo contain an abundance of *chír* of very fair quality. The Gori has a volume in time of flood nearly equal to the Pindar, and there is no obstacle in its course from the pine districts to the Káli. The *chír* forest along its banks, especially near Mastoli, are inferior to none in quality or quantity. The banks also are well-adapted to shooting down logs into the river, and labor is cheap and abundant. A mixed forest of silver fir and *A. dumosa* with box occurs on Húm Dhúra, but apparently too high up to be available for timber. The forests around Chipula abound with horse chestnut, sycamore, birch, yew, poplar, and wild fruits which grow up to 11,000 feet, above which is bare grass and rocks covered with snow till June. These are all too remote from the river to be available for timber for export. In the upper valley of the Káli there are numbers of *chír* along the precipices close to the river, scattered patches of the hemlock-spruce (*A. dumosa*) intermixed with the excelsa pine and considerable blocks of the silver fir, here called *wáman*, which occurs also in the Dárma valley, too far from the river for export. Box is found in the Gori valley near Milam, and in the Byáns patti under the name *pápri*. The grain of the wood appears to be coarser than that of the European species. The yew is as good as the European species for turnery and all purposes. The holly is close and even grained, and fit for turnery, and the species of birch known as *púyauts* yields a wood for doors and panels that bears a very high polish and is one of the best that we have. Besides these, maple, hazel, birch, wild apples, wild cherries and pears abound, all of which have their value as timber for turnery and other purposes. It cannot be denied that, as in the case of mines, much of the valuable timber trees of the inner Himálaya are in such a position as to render them practically useless for export; but should the necessity arise, some mechanical contrivance will doubtless be invented for the better and more easy removal of the logs to a stream that can carry them to the plains. The shoots that have been in use in Jaunsár for some years have materially assisted manual labour, and when advisable, the same principle can be applied to the removal of valuable timber from the forests of British Garhwál and Kumaun.

Forest Department.

We have now briefly sketched the character and position of each of the great State forests, and shall proceed to describe the system under which they are managed. The expenditure under 'forests' is divided broadly into that incurred on account of 'conservancy' and that for 'establishment.' The establishment protects the forests from trespassers, prevents unauthorised felling of timber, cuts down creepers and noxious undergrowth, marks trees for felling, repairs the fire lines, and superintends felling operations, both those undertaken on behalf of Government and those carried on by private individuals. The forest officer himself decides when felling operations may be undertaken, the principle observed being to work out distinct blocks as well for the sake of more easy supervision as to enable the department to open or close distinct areas at the same time. It is also the duty of the forest officer to superintend the felling, sawing, collecting and carriage to the depôt of the timber collected for Government; the counting, stacking, and classification of the logs in the depôt and the settlement of the accounts of contractors; the repair of old roads and the construction of new ones. The forest officer has charge of the collection of tolls at the forest stations. These are situate along the main lines of forest road, and in each there is a clerk and several peons. On the arrival of produce of any kind liable to toll, the clerk examines it, and the quantity and the duty received are entered in a book arranged in the form of a receipt and counterfoil. The clerk hands the receipt over to the exporter, and forwards a copy of the counterfoil to the head-office of the forest-division. The exporter proceeds with his load until he is stopped at a second line of posts established where the forest roads converge on the main public roads. Here he gives up his pass, and the goods are again checked and any deficient duty is collected. These passes are also sent to the head-office and compared with the copies of the counterfoils previously forwarded by the clerks in charge of the first line of posts. Deputy overseers inspect each post, and rangers patrol the intermediate spaces to prevent smuggling; and in addition the smallness of the tax makes it hardly worth the trouble and risk necessary to successfully evade the payment on petty ventures. It is only when the exporter bribes the whole establishment and removes valuable timber wholesale that any profitable result can be expected, and this may be considered a very remote contingency. The revenue collected is forwarded day by day from post to post to the nearest treasury, and the official in charge reports the amount received from each post to the head-office of the division, and this is again compared with the total entered in the passes and counterfoils.

Timber marts.

The principal timber depôts in the Kumaun forest-division are those at Rámnagar and Moradabad, and the markets for minor forest produce are at Chorgaliya, Haldwáni, Káladhúngi, Chilkiya, and Rámnagar. The Naíni Tál forest-division finds its market in the settlement itself. It has a special local conservancy staff, who superintend the felling of trees for timber, fuel and charcoal, the dues on which are collected according to a special table of rates. The Ránikhet forest-division is purely conservative and supplies only the local demand in the Ránikhet settlement. Khohdwára or Kotdwára, as it is more commonly called, is the great mart for the exchange of minor forest produce in Garhwál, and, for the sale of timber, depôts have been established in this division, both on the Rámganga and on the Ganges. Hardwár on the Ganges and Rájghát on the Jumna are the two great timber depôts for the whole Himálayan tract between the Ganges and the Tons, including the Dehra Dún, Jaunsár, and Bhágirathi forest-divisions. A considerable amount of timber and minor forest produce, however, finds a way to the plains through the passes in the Siwáliks to Saháranpur, Dehli, and Meerut. Good roads connect all these marts with the different lines of railway, and with the extension of the existing line from Bareilly to Pilibhít and Naini Tál, the communication, so far as Kumaun is concerned, will be complete and the value of the minor forest produce will be enhanced considerably. In appendix A. will be found a table showing the rates now levied on timber of all kinds and minor forest produce in the Kumaun forest-division. It has not been considered necessary to give these tables for every forest-division, though they vary slightly in details in each tract. Enough has been given to furnish a fairly accurate idea of the extent and character of the State impost on forest produce. Perhaps the most curious fact elicited is the number and variety of the articles coming under the head 'minor forest produce.' Here we have the drugs, tans, dyes, gums, reeds, fibres and grasses of the preceding pages, with the toll that is levied on them by Government, and the average annual export from the forest-division based on the returns of four years. It has been found impracticable to give a correct selling price for these articles: so much depends upon the locality and circumstances. The greater part is collected and exported by the poorer classes who exchange their goods for grain or clothes and earn but a scanty subsistence. Still confining our remarks to the Kumaun forest-division, some idea of the extent of the felling operations will be gathered from the fact that, between 1859-60 and 1879-80, the timber cut and and sold by Government agency amounted in this division alone to 3,010,241 cubic feet and the quantity cut and exported by private agency amounted to 2,620,607 cubic feet between 1865-66 and 1879-80. The greater portion of this timber was *sál* of good quality, though of late years second-class timber has come into considerable repute. In addition to this, great quantities of dry timber were exported by merchants at lower rates, and in the Kumaun Bhábar, many thousand acres of *sál*, *haldu*, *dhami*, and other trees were cut down and exported to make room for cultivation. No detailed account of the quantity can be given as the duty was usually levied by cart or bullock load. If we remember that similar operations are going on in each of the other forest-divisions bordering on the plains, some idea may be formed of the extensive nature of the forest operations. In Jaunsár and the Bhágirathi valley the principal export is timber for railway sleepers cut and exported by Government agency. Appendix A. gives the revenue and expenditure of all forests for as far back as the records appear accurate enough for reproduction.

Rheea.

Bœhmeria nivea, Hook. et Arn.; *Urtica nivea*, Linn.; *U. tenacissima*, Roxb.—China grass, rhea, rheea, ramie (Malay). Brandis, 402.

The rheea is indigenous in China, Japan, the Phillipine Islands, Java, Sumatra, the Indian Archipelago, Siam, Burma, Singapur, Penang, Asám, and Rangpur and Dinajpur in Eastern Bengal. It is cultivated in China, Japan, and the Indian Archipelago, where it is stated to like a moist soil, and flourishes best in alluvial deposits along the banks of rivers and generally in the fertile flats such as are found in its native haunts in China and Sumatra. The cultivation of the rheea in these provinces dates from the year 1863, and in 1865 there were several small plantations in the Dehra Dún. The Government plantations were begun in 1867 by devoting a small portion of the Chandwála garden in the Dún to the propagation of the plant for distribution to those who desired to embark in its cultivation. In 1870, the regular cycle of inquiries as to the value of the economic products of India brought rheea prominently to notice, and orders were issued for the extension of the existing Government plantations both in the Dún and at Sahāranpur. In 1871, a prize of £5,000 was offered to the inventor of the best machine or process for the preparation of the fibre, and in the same year, instructions were issued for the supply of stems for a trial between competitors for the prize and for distribution for preliminary experiments to all who were likely to make use of them both in this country and in England. During the year 1871-72, the area under rheea in the Dún and at Sahāranpur exceeded 37 acres, and upwards of nine tons of stems were forwarded to England for the use of intending competitors.

First competition.

The first trial for the prize took place at Sahāranpur in August, 1872, when a machine, the property of Mr. J. Greig of Edinburgh, was entered for competition. The following extract from the official report of the trial will show what degree of success was obtained:—

"The machine, as a piece of mechanism, is good, it is well-made and well-proportioned, the relative strength of the various parts having been well considered.

It is calculated to wear well, and deserves commendation so far as being a good substantial piece of work. The machine, however, as must always be the case with machines of this kind, *i. e.*, contrived to do a work of which there is little or no experience available and without means of obtaining the natural material to work upon, is far from matured. Few, if any, of such machines are ever constructed at once able to do the work for which they are intended; most are generally perfected by degrees through numerous partial failures; experience gained in the process of working alone enabling many defects to be seen and remedied and a perfect machine to be produced, and such appears to be the case with this mill; for, independent of whether it is or is not the best description of machine for preparing the fibre, it is, on the one hand, in many points very deficient in the work *the exhibitor sets it forward to perform, while, on the other hand, it is* certain that it can be improved in much that is faulty."

Mr. Greig was awarded £1,500 for his machine, in consideration of the skill, labour, and expense incurred in its construction, and in recognition of its being a real attempt to meet the wants of Government.

Second competition.

In 1873-74 and 1874-75, the area under rhea was maintained at 37 acres, and in 1875-76 further instructions were received to continue the supply of stems for experimental purposes. In August, 1877, the offer of a prize of £5,000 was renewed, and the following specification of the machine required was published for general information in India, Europe, and America :—

"What is required is a machine or process capable of producing, by animal, water, or steam power, a ton of dressed fibre of a quality which shall average in value not less than £45 per ton in the English market, at a total cost, including all processes of preparation and all needful allowance for wear and tear, of not more than £15 per ton, laid down at any port of shipment in India, and £30 in England, after payment of all the charges usual in trade before goods reach the hands of the manufacturer. The processes of preparation are to be understood to include all the operations required subsequent to the cutting of the stems from the plants in the field, until the fibre is in a condition fit to be packed for conveyance to the market. The machinery employed must be simple, strong, durable, and inexpensive, and should be suited for erection in the plantations where the rhea is grown. It must be adapted for treatment of the fresh stems as cut from the plant. The treatment of dried stems offers certain difficulties, and the fibre prepared from them must, moreover, always be much more costly than the fibre produced from green stems. Except during the hot, dry, weather preceding the rains in Upper India (where rhea grows best), it is very difficult so to dry the stems that no fermentation or mildew shall occur. But during this season the stems are comparatively *short and the crop poor and stunted, unless it is artificially irrigated*, and such greatly increases the cost of cultivation. In the rainy season the plant is in fine condition, but at this season it is almost impossible to dry the stems in quantit without injuring the fibre, unless recourse is had to artificial means of desiccation, which greatly increase the cost of the material. It is therefore obvious that the attention of inventors should be given to the discovery of a process for the treatment of the green stems."

Result.

The trials commenced in September, 1879, at Sahâranpur, and ten competitors entered machines of different kinds, of which three were withdrawn. The following is an abstract of the results :—

Competitor.	Green stems worked up				Total fibre obtained.	Percentage of fibre.	Cost per ton.		
	Tons	qrs.	cwt.	lb.	lb		Rs.	a.	p.
M. Z. P. Vander Ploeg ...	1	14	0	0	118⅓	3·11	337	8	0
Dr. Collyer	1	0	0	0	147	6·60	112	0	0
Paris machine		...			104	...	483	14	0
M. Nagona	3	7	3	0	337⅛	4·44	38	14	4
Mr. Cameron	1	2	3	0	$92\frac{3}{16}$	3·01	270	12	0
Mr. Amery	1	10	0	0	$107\frac{15}{16}$	3·21	418	0	0
Mr. Blechynden	0	11	1	0	58¼	4·68	251	4	6

The judging committee consider that the limit of £15 per ton for the cost of preparation and laying down the fibre at a port of shipment in India would render competition practically impossible from a place so distant from the sea-board as Sahâranpur. Further, that the plant grown at Sahâranpur is not calculated to give such good results as that grown in more suitable localities, but that, on the whole, the experiments made during the trials, though not decisive, have gone far towards establishing the conditions under which a fair verdict can be awarded and have advanced an important step in the progress made towards the solution of the problem. The awards have not yet been published, as they depended on the valuation of the fibre in the English market. The advance made in this competition shows that the invention of a successful machine is merely a question of time and justifies the resolution of Government to continue the supply of rheea stems for experimental purposes.

Cultivation and prospects.

The Dutch botanist Blume, in his report on the cultivation of rheea in Java and Sumatra, states that "the plant thrives best in shade, in a moist and fertile soil : conditions such as are usually found in abandoned coffee plantations. * * The plant thrives best in the hilly parts of the country in which rain is frequent. In the plains it would require irrigation." The conditions under which the plant flourishes in the countries best adapted to its growth are a moist tropical atmosphere, a shady situation and a low-lying alluvial soil. These conditions do not exist in Sahâranpur. In the cold season, so soon as the temperature falls to about 40°F., the whole crop, leaves and stems, become black and fall to the ground. The roots then remain dormant until January, when the fields become green again with the young shoots. As the weather becomes warmer, the plants require irrigation at regular intervals of time, and weeds must be removed until the plants are strong enough to keep them down. The stems also are very short, owing to the effect of the hot dry winds which prevail in these provinces, and they ripen irregularly from the same cause, the tops being often green and soft, whilst the lower portions are ripe and hard. Until the meeting of the competitors in 1879 it was not known how inferior the Sahâranpur stems were when compared with those raised in more suitable climates. During this trial, stems grown in Dehra and Calcutta were found to give better results than the local produce, presumably owing to their having been raised in a moister climate. A healthy stem is described as an evenly shaped flexible wand of a length varying from 5-7 feet with the same colour throughout and ripening in all parts simultaneously. The Sahâranpur stem was generally an irregularly shaped stick, 3-5 feet high, of uneven growth, with irregular distances between the joints. Many of the stems were stunted and imperfectly nourished and unequally ripened. The conclusion arrived at by the committee was that either the cultivation was insufficient or the climate is unsuitable. Experiments are now being made to ascertain whether trenching and heavy manuring will correct the defects observed, but it is believed that, as with most plants, climate is the first consideration, and therefore rheea cultivation in the drier parts of these provinces can never be more than partially successful. There is no difficulty in raising the plant from seed or in propagating it by cuttings. Dr. Jameson has estimated that an acre will yield four crops in the year, aggregating ten tons of green stems. Taking the yield of fibre at one-twentieth of the green stem, the return of marketable fibre per acre will be half a ton. The value of rheea-fibre in the English market at present is from £10 to £60 per ton, according to quality, a price that should always leave a fair margin of profit to the cultivator of the plant and the preparer of the fibre.

CINCHONA.

For several consecutive years previous to 1872, experiments were undertaken in the valleys and hills of these provinces for the cultivation of the cinchona plant. It was tried at Chandwála and other localities in the Dehra Dún at 2,500 feet, at Chhajauri in Garhwál at an altitude of 4,500 feet, and at Mussooree at an altitude of 6,500 feet. In Kumaun, experiments were made in the Bhábar at 2,000 feet, at Háwalbágh at 4,500 feet, at Ayár-Toli and Ránikhet at 6,000 feet, and at Arkalli at 6-7,000 feet. In all these places, except the Bhábar, the plants progressed during the hot weather and rains. It was considered necessary to protect the young trees from the frost during the cold weather, and this was done for three years and until many of the plants had attained a height of 4-6 feet. These, with many others ranging 2-3 feet, were then left uncovered during the cold weather, with the result that every one of them perished in all the localities mentioned. Similar attempts proved unsuccessful in the Kangra Valley and Panjáb Himálaya. In Kangra, where many of the plants had reached 4-5 feet in height, a single winter's frost was found enough to destroy them, and at Ránikhet, plants of *C. succirubra*, 4-5 feet in height, were cut down by the frost, though partially protected. Dr. Jameson closes his account[1] of these operations with the following remarks :—"To continue the growth of the plant as an experiment in view to the cultivation for economic purposes would be a mistake, and the time therefore has come to close the experiment which has been carried on with the utmost labour, care, and attention, and to declare that the valleys and hills of the Himálaya of the North-Western Provinces and the Panjáb are not fitted for the cultivation of the cinchona plant."

TALLOW TREE.

Stillingia sebifera, Michx.—Tallow-tree.

A tree belonging to the natural order *Euphorbiaceæ*, introduced from China. This tree fruits abundantly in all climates in India from Calcutta to the Himálaya. There are large plantations in Sahéranpur, the Dún, and on the several tea-plantations in Kumaun. The seeds were sown in the Sahéranpur gardens in 1858, and so rapid was their growth that, in 1866, they measured 6 feet in circumference 3 feet from the ground. Plantations were established in the Dehra Dún, at 4-5,000 feet in the hills at Hawalbágh, Ayár Toli, and Páori, and in all these places there was an abundant yield of fruit. The seeds lie within a capsule and are enveloped in a fatty matter which yields a tallow. Animal tallow consists of stearine and elaine, both of which are found in nearly a pure state in these seeds. The mode of extracting[1] the tallow is very simple. It is merely necessary to boil the seeds and strain through cloth into water; and to purify the tallow, boil again in water and strain through a cloth as before. For burning purposes the tallow is excellent, as it gives a clear, bright, inodorous flame without smoke. It has also been tried with some success as a lubricator for railway wagons. The wood is close-grained and yields a timber well fitted for printing-blocks, and the leaves afford a dye. It was thought, at one time, that the cultivation of this tree in Kumaun would yield results second only to tea, but actual experiment has shown that the labour and expense involved in collecting the seeds and extracting the tallow are far in excess of the value of the product; and in Calcutta, where it was introduced over thirty years ago, the result has been the same.

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[1] Sel. Rec., N.-W. P. (2nd Ser.), VI., 602, and Dick's Report, *ibid.*, I., 79.

IPECACUANHA.

Cephœlis Ipecacuanha.—In 1870, Dr. Jameson procured two plants at the Kew Gardens and brought them out to India, where they arrived safely and were planted in the gardens at Chandwála in the Dehra Dún, but ultimately perished from frost.

CORK OAK.

Quercus suber, Linn.—Cork oak. Brandis, 485.

At various times seeds of the Italian and Spanish cork oak have been planted in Dehra Dún and have germinated freely. The young trees thrive well and may, hereafter, prove of value, but the ultimate success of the experiment has yet to be seen.

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[1] For Dr. Macgowan's description f the process of manufacture in China, see J. Agri.-Hort., Ben., VII, 164.

SWEET CHESTNUT.

Castanea vulgaris, Linn.; *C. vesca*, Gærtn.—Sweet chestnut, Spanish chestnut, châtaignier. Brandis, 491.

The seeds of this tree were introduced by Sir John Strachey, and subsequently consignments were received by the Superintendent of the Botanical Gardens, Sahâranpur, by whom they were planted and the young trees distributed all over the Dún and Kumaun. The chestnut yields freely in the Dúns and Lower Himálaya, and now forms an appreciable addition to the fruit resources of the Dehra bazar. In Italy, Greece, Central France, Spain, and Corsica, it forms an important article of food for the inhabitants of the mountainous regions of those countries, and from the success of the experiments tried here, it appears that the establishment of the chestnut in suitable localities in these hills presents no difficulties that cannot be easily surmounted.

CAROB.

Ceratonia Siliqua, Linn.—Carob or St. John's bread-fruit tree: the Algaroba beans of commerce (fruit). Brandis, 166.

The carob was introduced by Dr. Jameson from Malta in 1861, and by 1863 it was extensively propagated and distributed in the Dún. The trees, though they flourish well, do not seem to give pods in such quantities as they yield in Malta and Italy. In 1866, the same report was received, and in 1880, it has been decided to try to improve the quality of the seeds by grafting, which, in Italy, not only produces better fruit, but gives a yield in a much shorter space of time. The trees appear to be unaffected by any extremes of temperature or excessive moisture. The sweet nutritious pulp of the pods is ground and mixed with grain and then baked and eaten by the poorer classes in Italy, the Levant, and Malta. The pods are also given to draught cattle in the proportion of one measure of carob beans to two measures of barley, and on this food they both work and thrive well. This tree is indigenous in Spain, Algeria, the eastern part of the Mediterranean region, and Syria.

MEZQUIT.

Prosopis glandulosa—The Mezquit bean.

This plant, a native of Texas, was introduced in 1878, and has been successfully propagated in Kumaun. It produces pods freely during the rains, not all at once, but in succession, and seems to stand the extremes of heat, cold, and moisture very well. The beans are used as fodder for cattle. *Acacia tortuosa*, a native of Jamaica, has recently been introduced. It yields a fodder pod and might be cultivated as a hedge as well. It thrives well at Sahâranpur. The *Euchlæna* (*Reana*) *luxurians*, which yields a good fodder grass, is also under trial in the Government gardens, as well as a series of Australian grasses. The *Pithecolobium Saman*, or 'rain tree,' has been found a failure, not being able to withstand the frosts in the cold weather. Several experimental sowings of fibre plants have also been made. Dr. Jameson recommended the cultivation of *Agave Cantala* and *americana*, *Aloe angustifolia* and *intermedia*, *Sanseveria zeylanica* and *Tacca stricta*. A recent report on *Malachra capitata* shows that it grows to a fair height and seeds freely, producing a fibre, however, in no way superior to the indigenous *patsan* (*Hibiscus cannabinus*), but useful for mixing with jute in the manufacture of bags. Some forty species of *Eucalyptus* have been cultivated. All seem to thrive fairly, and some of them remarkably well in Sahâranpur and the hills. *Catalpa speciosa*, Engel., a tree indigenous to North America, yields a timber especially adapted for underground work, such as posts, sleepers, and the like, and is now under cultivation in Sahâranpur, and will also be tried in Mussooree. Olives have been received from Florence and are now planted out at Chajauri, where they appear to thrive well, the climate and soil being very suitable. They are of the same species as that from which the famous Lucca oil is extracted. A considerable number of seedlings of the oil-plant, *Lallemantia iberica*, raised in Sahâranpur have been planted at Mussooree, but it will take some time before a correct estimate of its value can be obtained. Madden records that hops were raised with some success in Hawalbágh in Kumaun over thirty years ago, and experiments in the Dún in 1862-63 showed that they grow well there also. In the plains, however, the flowers do not seem ever likely to be useful for brewing purposes. Hops grow well at Sahâranpur, and during the rains become most luxuriant; but it also happens that the flowers are produced at that time and the heavy rain prevents their proper development. This would appear to be a matter that should affect the culture of the hop plant in this country wherever the periodical rains are felt, and would apply to the whole of the Himálaya of these provinces equally with the plains. In conclusion, mention may be made that fruit trees of all kinds, vegetables, flowers, and ornamental shrubs, have been introduced and propagated and distributed all over the hills from the Tons to the Sárda, and that for this purpose the gardens at Mussooree, Chajauri and Ránikhet have well fulfilled the object for which they were established.

TEA.[1]

Tea.

The history of the cultivation and manufacture of tea in the hill districts of the North-Western provinces having originated simultaneously with the introduction of the plant in India generally, and with its discovery as an indigenous plant in Asám, it will be advisable to commence with a brief sketch of the circumstances which have led to the undoubted success of tea culture in these provinces.

History.

The claim of first originating the idea of cultivating the tea plant in India is variously attributed. As early as 1788 it appears that Sir Joseph Banks, at the request of the East India House, wrote a memoir on the subject,[2] recommending the introduction of plants from China to Behar, Rungpur, and Kuch Behar. Some years afterwards considerable interest was aroused by the reported discoveries of indigenous tea plants in Burma, Asám, Nepál, Kumaun, and Basáhr. It was in Asám only, however, that the discovery of the truly indigenous plant was confirmed. Mr. Burrell is inclined to believe that the discoverer of the wild tea plant in Asám was Mr. David Scott, an Indian civilian, who, when Asám was ceded to us, took charge of the settlement of that province. It appears that some time between 1819 and 1821 he sent a specimen of the Asám wild tea plant to Calcutta to his friend Mr. James Kyd, whose father, Colonel Kyd, corresponded with Sir Joseph Banks about tea cultivation in India amongst other matters. This specimen was handed over to Dr. Wallich, and Mr. Burrell has succeeded in identifying it in the Wallichian herbarium now belonging to the Linnean Society. Attached to the specimen he found a portion of Mr. Scott's letter, but without any indication as to the date. The conclusions arrived at by Mr. Burrell are fully borne out by Mr. Thiselton Dyer, who, being the author of a monograph on the Indian *Ternstrœmiaceæ*, must have made a special study of this subject; also by the late Dr. Anderson and Dr. McClelland. In a letter from the latter to Mr. Clerk Marsham the following passage occurs :—

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[1] I am indebted to Mr. J. F. Duthie, Superintendent of the Botanical Gardens, N.-W. P., for this notice of the tea industry in Kumaun.

[2] See an interesting paper read by Mr. A. Burrell before the Society of Arts on February 2nd, 1877, and published in the Society's Journal, Vol. XXV., p. 199.

> "The circumstances brought to light by Mr. Burrell coincide exactly with what I have always understood to be the fact, that specimens of the plant and seeds of the indigenous tea plant had been sent by Mr. Scott through Mr. Kyd to Dr. Wallich as early at least as 1821."

And further on he remark :—

> "Had Mr. Scott's discovery in 1821 been taken up in an active and enlightened spirit, several years might have been gained, but public spirit was not prepared at that period for much enterprise, and we were content to receive our teas from China. Besides, Mr. Scott had not at that time reduced the tribes on the frontier to subjection, and their troublesome character was kept alive by our war with Barma, and, above all, we wanted Lord William Bentinck, without whom the second discovery of the tea plant might have shared the fate of the first. What we have most to regret is that Mr. Scott's discovery was not properly recorded, when steps might have been taken, with his assistance, for the transmission of seeds and plants to the Botanic Garden in Calcutta, where the tea plant could have been propagated twelve years before its subsequent discovery in Asám."

Other writers on the early history of Indian tea have mentioned Mr. Bruce as having first discovered the true tea plant in Asám, but as his discovery was only made in 1823, his claim must give way to that of Scott.

The Kumaun plant noticed by Bishop Heber on his visit to Almora in December, 1824, as well as that of Basáhr, described by Moorcroft in 1821, must be referred to an evergreen shrub called *Osyris nepalensis* and belonging to the sandal-wood family. Bishop Heber thus writes concerning this plant. "The tea plant[1] grows wild all through Kumaun, but cannot be made use of, from an emetic quality it possesses. This might, perhaps, be removed by cultivation, but the experiment has never been tried. For the cultivation of tea I apprehend both the soil, hilly surface, and climate of Kumaun, in all which it resembles the tea provinces of China, are extremely favourable." The plant observed in Nepál was a true tea plant in cultivation, and which Dr. Wallich afterwards ascertained to have been brought from Pekin on the occasion of one of the triennial embassies sent to China by the Gorkháli government.

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[1] Regarding the same plant Dr. Royle in his "Illustration of the Botany of the Himalayan Mountain," p. 322, says :—"The leaves of this plant are in Kumaun employed as a substitute for tea : hence some travellers have been led into the error of stating that the true tea plant was to be found in this part of the mountains."

Tea cultivation in the Himálaya.

The idea of cultivating tea in the hill districts of Northern India was first originated by Dr. Royle in 1827, who was at that time in charge of the East India Company's Garden at Sahāranpur. In a report to the Government of India, at the close of that year, he pointed out the resemblance of the Himálayan vegetation with that of tea-producing districts of China, as well as the suitability of the soil, especially in Kumaun. Four years later he again expressed these opinions[1] to the Governor-General, Lord W. Bentinck, during the visit of the latter to Sahāranpur. The representations of Dr. Royle from Sahāranpur, and of Dr. Wallich at Calcutta, and of other writers, eventually led in 1834 to the formation by Lord W. Bentinck of the Tea Committee. The chief object of this committee was to ascertain the best mode of introducing the Chinese tea plant into India, and of its cultivation in carefully selected localities. One of the first acts of the committee was the deputation of Mr. G. J. Gordon to China in order to arrange as to the best modes of obtaining both the genuine plant as well as Chinese cultivators. In the meantime, arrangements were being made to select the best localities in India for sowing the seeds which were expected to arrive before the end of the year (1834). At the same time a set of queries was circulated by the committee for the purpose of obtaining the opinions of those who were most competent to give their advice on this matter. Two important communications were received in reply—one from Captain Jenkins, Agent to the Governor-General in Asám; and the second from Dr. Hugh Falconer, who had recently succeeded Dr. Royle as Superintendent of the Sahāranpur garden. After describing the conditions under which the tea plant was being cultivated in China, and the attempts which had been made to introduce the plant to other countries, he observes :—

> "There is, perhaps, no part of the Company's territories in India which supplies all the conditions of tea districts in China in respect of climate; but there are situations which approach it so nearly as strongly to bear out the

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[1] See also his "Ill. Him.," pp. 124-27, where these views are more fully stated.

conclusion that tea may be so successfully produced in this country as to be an object of high commercial importance. * * * * *
It has been seen that the annual heat of the southern limit of the tea cultivation in China, assumed to extend to Canton, is 73° F. At Saháranpur, which may be considered as at the northern limit nearly of the plains of Hindustan, 8° of latitude higher, and 1,000 feet above the sea, the mean temperature of the year is 73° F.; the temperature of June is 90°, and of January, 52°.

"In the Himálaya mountains this case is widely different, excepting periodical rains; here all the conditions of the temperate climate are found, and here, above all parts of India, we may look for successful cultivation of tea."

After describing the geological features of these mountains, having made a special study of the subject, he summarizes his opinions as follows:—

1. "That the tea plant may be successfully cultivated in India.

2. "That this can be expected nowhere in the plains from 30° north down to Calcutta.

3. "That in the Himálaya mountains near the parallel of 30°N., notwithstanding some circumstances of soil and moisture of climate, the tea plant may be cultivated with great prospect of success; that a climate here may be found similar in respect of temperature to the tea countries in China; that in the direction and great slope of the hills, the absence of table-land or elevated valleys, and the contracted figure of the existing valleys, are the chief difficulties in the way of cultivation, which may prevent tea from being produced in great quantity on any one spot.

4. "That the most favourable ground for a trial is a tract on the outer ridges, extending from 3,000 feet above the sea, or the point where the hot wind ceases, up to the limit of winter snow.

5. "That in the valley of the Dhoon, if not the better, the inferior sorts of tea might be produced."

The opinions expressed by Dr. Falconer in the above letter are remarkably similar to those of Dr. Royle submitted from England about the same time; and, as the latter declared, "without any communication of ideas, for the two essays must have crossed each other at sea." Among the localities recommended by Dr. Royle were Bhím Tál, Háwalbágh, Dehra, and Pinjor in valleys from 2-2,500 feet in elevation above the sea; also Almora, Jerrapani, Nahan, and Subáthu at elevations of 4 to 5,000 feet; also Mussoorie at 6,500 feet.

Dr. Falconer.

Shortly after this Dr. Falconer received orders to examine the hill country situated between the Jumna and the Ganges for the purpose of selecting suitable sites for tea nurseries. In view also of the experiments that were to be undertaken in Kumaun, a letter was addressed to Mr. G. W. Traill, Commissioner of that province, by Dr. Wallich, Officiating Secretary to the Tea Committee, dated 28th June, 1834, requesting him to render what assistance he could in order to carry into effect the object in question. In Mr. Traill the Government found an officer well qualified to undertake this work. He was assisted by Mr. R. Blinkworth, who was then at Almora acting as plant-collector under Dr. Wallich for the Calcutta Botanical Garden. Two sites were chosen for nurseries in which to sow the seeds that were shortly expected from China. They were—Lachhmesar near Almora and Bhartpur near Bhím Tál. They are thus described by Mr. J. H. Batten, B.C.S., who was afterwards Commissioner of this province,[1]—"the former occupying three acres of old and easily acquired crown land on the north-west slope of the hill below the capital town at 5,000 feet above the sea, the latter occupying four acres at 4,500 feet above the sea in the near neighbourhood of the Bhím Tál lake, which is situated on the first step of the mountains above the Bhamauri Pass." It was in this same year (1834) that through the energetic researches of Captain Jenkins and Lieutenant Charlton some specimens of the true tea plant of Asám were obtained, and thus confirmation was secured as to its being really wild in that country.

Sites.

The question of selecting sites gave rise to much discussion; some, such as McClelland, Griffith, &c., being in favour of restricting cultivation to Asám, or to countries with a similar climate, on the assumption that a damp and equable climate was necessary for its proper growth. As far as the Asám plant was concerned, this has been proved to be good advice, and results have shown that though the Asám tea plant is botanically the same species as that of China,[2] it is not sufficiently hardy to bear the extremes of temperature to which the Chinese variety is exposed in the tea gardens of North-

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[1] "Notes and recollections of tea cultivation in Kumaun and Garhwál," by J. H. Batten, B.C.S., retired, Journal, Agri-Hort. Society of India, Vol. V., Part IV., p. 53, 1878.

[2] See F. Ind., I., p. 292.

Western India. In China itself, where the area of tea cultivation extends over nearly twenty degrees of latitude, there must be many degrees of hardiness in the plants which are grown throughout this wide extent of country.

Tea-plant discovered in Asám.

Previous to the rediscovery of the tea-plant in Asám, the sites recommended for cultivation in India had reference solely to the Chinese plant, as far as was known about it at that time. In most cases these sites have proved successful so long as cultivation was restricted to the Chinese variety, or with hybrids only slightly crossed with that of Asám. The pure Asám plant, on the other hand, requires a hot and moist climate; in fact the more unhealthy the locality may be from the above cause, the greater the chances of success. The discovery of the true tea-plant in Asám naturally gave rise to a considerable amount of partiality in favour of restricting the cultivation of tea entirely to that country or its neighbourhood; and consequently attention was diverted from the more distant nurseries in Kumaun and Garhwál. These nurseries, however, were in good hands, and, in spite of all drawbacks, the success of the experiments soon became evident. At this point, it will be advisable to confine attention to matters more immediately connected with the subject of this notice, *viz.*, the progress of tea cultivation in Kumaun and Garhwál.

Cultivation in Kumaun.

The *first batch of plants numbering about 20,000 were despatched* from Calcutta in 1835, but very few of these arrived at their destinations alive; and of the seeds sent to Dr. Falconer not one germinated, a fact not to be much wondered at, considering the length of the journey they had to undergo, and the short-lived nature of the seed. The plants flourished in the two Kumaun nurseries and produced abundant crops of seed. In the Saháranpur garden plants were also to be seen, the offspring of seed produced at Koth in Tihri-Garhwál. In 1841, Dr. Falconer, who was then in charge of all the tea plantations in Northern India, visited the two Kumaun gardens. At the Bhartpur nursery he found 1,344 plants. Of these, 291 were original plants introduced in 1835; 153 were seedlings of 1840, and the remainder were from layers made in this and the two preceding years. At Lachhmesar there were 3,840 plants; *viz.*, 250 of the original plants of 1835, 2,072 seedlings of 1839 and

1840, and the rest layers. The greater success of the latter garden he attributed partly to its better site, but in a great measure to Mr. Blinkworth, who happened to be residing in the neighbourhood. On the whole, he considered the results up to this time as most encouraging. Shortly after this he paid a visit to the Garhwál nurseries and reported similar progress. As far, therefore, as the plants were concerned, everything looked promising; but nothing was known as to the quality of the leaves for the manufacture of good tea. At that time there was very little practical knowledge in India regarding the various processes of tea manufacture, and in order to avoid unfavourable opinions at the outset through the attempts of unskilled workmen, Dr. Falconer strongly recommended that two complete sets of Chinese tea manufacturers should be supplied for the nurseries in Kumaun and Garhwál, especial care being taken that these men should be of the best description.

Chinese labour imported.

A small manufacturing establishment was accordingly sanctioned by Government. Some men who were selected for this work by the Commissioner of Asám declined to go to Kumaun. Dr. Wallich, however, succeeded in engaging the services of a party of Chinese artizans in Calcutta. These were accordingly sent up to Kumaun, together with a set of implements all under the charge of Mr. Milner, who happened to be on his way to Saháranpur to take up his duties there as Head Gardener. They arrived at their destination in April, 1842. The Chinamen, as soon as they saw the Kumaun tea bushes, all declared that it was the genuine China plant; and, in their opinion, far superior to that of Asám. They recommended that the plants should be pruned down close to the ground, so as to encourage the production of a fine crop of young leaves in the succeeding spring. They managed to make a small quantity of tea with the leaves of that year, a sample of which was taken to England by Dr. Falconer a few months afterwards. This sample was submitted to the celebrated tea-brokers Messrs. Ewart, Maccaughly, and Delafosse in London in September, 1843, and they reported as follows:—"The tea brought by Dr. Falconer as a specimen of the growth of the China plant in the Himálaya mountains resembles most nearly the description occasionally imported from China under the name of *Oolong*. This resemblance is observable in the appearance of the leaf before and after infusion. The colour of the liquor is also similar, being paler, and more of the straw colour than the general description of black tea. It is not so high flavoured as the fine *Oolong* tea, with which we have compared it, and it has been too highly burnt in the preparation, but it is of a delicate, fine flavour, and would command a ready sale here."

Dr. Jameson.

After the departure of Dr. Falconer, the Saháranpur garden was put under the charge of Dr. W. Jameson, whose energy and indomitable perseverance contributed mainly to the success of tea cultivation in Northern India. He was also an active witness of the progress of tea cultivation from its experimental stage to the period when its profitable cultivation justified the Government in handing it over to private enterprise. A sample of probably the same tea as that of Dr. Falconer above referred to was sent by Dr. Jameson to the Calcutta Chamber of Commerce, where it was pronounced to be a tea of very good marketable value, and worth in London about 2*s*. 6*d*. per pound. Another portion of this sample sent to London was reported on by Messrs. Thomson of Mincing Lane, and pronounced to be of "the *Oolong Souchong* kind, fine-flavoured and strong. This is equal to the superior black tea generally sent as presents, and better, for the most part, than the China tea imported for mercantile purposes." Dr. Jameson visited the Kumaun plantations in April, 1843, and found them in a very satisfactory state. The Chinamen were manufacturing a different kind of tea which appeared to be far superior in quality. Some samples of the above contained in sixteen small canisters were despatched in August to the India House. The flavour of this tea was somewhat spoilt by the wax-cloth in which the canisters were wrapped. In other respects, however, the reports were most satisfactory.

1844.

The history of the progress of the various tea plantations in North-Western India from this period, *i.e.*, from the year 1844 until a few years ago, when the last of the Government gardens passed into private hands, is chiefly to be gathered from Dr. Jameson's annual reports to Government, some of which have been published in the Journal of the

Agri-Horticultural Society of India.[1] In his report, dated 28th February, 1844, he gives a full account of the Kumaun nurseries, *their number and extent, as well as the number of plants contained* in each; he also enters into some particulars regarding the mode of *manufacturing the tea.* There were at this time five separate nurseries scattered over four districts; their total area amounted to 55 acres, and they contained 4,306 tea-bearing plants. More land being required, new nurseries were marked out by Dr. Jameson, and some of the old ones were extended, making in all an addition of 66 acres. Dr. Jameson's intimate knowledge of geology enabled him to select these new sites with great advantage. The total quantity *of tea manufactured in 1843 was 191lb. In discussing the* future prospects of tea, Dr. Jameson clearly shows the success of the experiment so far, and urges the necessity of greatly extending the cultivation of tea in the provinces of Kumaun and Garhwál. He says:—

> "The plants now amount to 150,000, and these will be doubled, I trust, or trebled annually; and were there only seed in sufficient numbers, as they germinate most freely, provided they are fresh, the aspect of the nurseries in an infinitely short space of time would be changed; for instead of patches there would soon be districts covered with tea plants * * * * *
> The nursery at Kaulagir in the Dehra Dún contains about 4,500, and here the plants are thriving as well as in any other of the nurseries. It is, however, to be proved whether the leaves yielded by the plants in this locality are fitted for making tea of a superior quality, as it has been ascertained that all the tea grown in China at low elevations is of an inferior description. If, however, it does prove to be a marketable article, and equal to that produced in the neighbourhood of Canton, a vast field for enterprise will be opened up, whether Government considered it worthy of their own attention, or it be brought about by private capital. Water carriage will soon, it is hoped, be within two or three marches of this valley, which will also be a strong inducement, in addition to the above, to make capitalists invest their capital in this channel, and thus we trust ere long to see the hill provinces, *which at present yield but a trifling sum to the revenues of the State,* become as important, in an economical point of view, as any of those in the plains of Hindustan."

In a letter to Dr. Royle dated 1st July, 1844, Dr. Jameson after having made an inspection of all the nurseries writes:—"At Koth, Ráma Serai, and Gadoli in the Garhwál Hills, the tea plants are thriving admirably, many of them being nearly six feet high." In a later letter he informs Dr. Royle that the Chinese manufacturers denied that green and black tea were made from different plants, and that it was only a difference in the mode of manufacture. In another letter he mentioned that 436lb. of tea had been made, and that three acres yielded 162lb. of tea; that he had then 120 acres under cultivation, and hoped soon to have double this area.

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[1] See Vol. II., p. 323; Vol. IV., p. 173; and Vol. VI., p. 61. For the first few years Dr. Jameson corresponded regularly with Dr. Royle, and the substance of his letters is contained in a paper by the latter published in the Journal of the Agri.-Hort. Soc., Vol. VII., part II., p. 11.

1845.

In Dr. Jameson's next report, published in 1845, he gave a detailed account of the progress made during the preceding year at the several gardens in Kumaun and Garhwál. Seventy-six acres of land were added and 94,100 plants were put into them. In September and November upward of four lacs of seeds had been sown, of which 167,000 germinated and were still germinating. Three hundred and seventy-five pounds of tea were manufactured, showing an increase of 185 lb. on the preceding year; and as the plants were still young, Dr. Jameson was confident of a steadily increasing quantity per acre every year. In this report he entered into the subject of cost and profit, and shows by the following estimate the amount of profit that might be realized from 6,000 acres of tea, on the assumption that an acre was capable of yielding one maund of tea :—

	Rs.
The expenses of cultivating 6,000 acres ...	... 87,000
Ditto of making the tea	... 30,975
Ditto of packing the tea	... 2,259
Land rent, carriage to Calcutta, &c.	... 36,500
Total	... 1,20,734
To value of 6,000 maunds of tea or 240,000 seers at Rs. 2 per seer	.. 4,80 000
Or say that the tea sold at Re. 1-8 per seer ...	... 3,60,000
Expenditure	... 1,20,734
Balance	... 2,39,266

Garhwál.

Regarding the Garhwál nurseries, Dr. Jameson reports that that of Kaulagir in the Dehra Dún consisted of six acres and contained 8,000 plants. At Koth in the Bhaddri valley, elevation 5,000 feet, there were 729 plants; and in the Ráma Serai nursery, elevation about the same, 728 plants. About a quarter of the total number in the two latter nurseries were a portion of the plants which came originally from Calcutta. Another nursery at Gadoli near Páori, established by

Dr. Jameson in 1843, contained 5,000 plants. Shortly after this Dr. Jameson sent a sample of Dehra Dún tea to Dr. Royle for an opinion, which was favoured by Mr. R. Twining, who reported as follows:—"I have carefully tasted your sample of Himálayan tea, and I really think it a promising specimen. The flavour is not strong, but it is delicate and pleasant, and a little, methought, of the *Orange Pekoe* character. The complexion of the leaf is rather good, and pains seem to have been taken in the manipulation." This favourable account was very gratifying to Dr. Jameson, who at once foresaw the profit that would result by extending tea cultivation throughout the Dún. Other samples were submitted through the Court of Directors for professional examination in London, and the reports, on the whole, were most satisfactory. Dr. Jameson received about this time from the Court of Directors grateful acknowledgment for the good work already done by him. The sales of tea at Almora, two of which had lately been held, showed an increasing appreciation of Indian tea by natives as well as by Europeans. The average price offered for black tea was seven rupees per seer. In 1847, Dr. Jameson wrote to Dr. Royle:—"The tea this year will, I think, be very superior to anything yet made, as it has been manufactured and packed under advantages which were not procurable until now; that is, there is now a sheet-lead maker attached to the manufactory." Another sale was held this year at Páori. The amount realized for green tea varied from Rs. 10-8-0 to Rs. 9-4-0, and black from Rs. 7-8-0 to Rs. 4 per seer. About this time, Dr. Jameson received orders to select sites for new plantations in the hilly districts between the Satlaj and the Ravi, which resulted in the establishment of the Kangra valley nurseries.

Third report.

Dr. Jameson's third report[1] gives further details regarding the condition of the different nurseries. His observations as to soil were to the effect that the tea plant thrives well both in stiff and free soils, but apparently better in the latter, or in a mixture of the two; with regard to elevation, that it thrives equally well at heights ranging from 2,200 feet above the sea to 6,000 feet. The area under cultivation at this time was 162½ acres, and the minimum yield of tea per acre was 80lb. It is also stated in this report that about half the quantity of the '*Pouchong*' (black tea) was bought up by natives at an average price of Rs. 6-8-8 per seer. The coarse *Bohea* tea was sold to the Bhotiyas at from Rs. 2 to Rs. 2-4-0 per seer for export to Tibet, where it successfully competed with the tea imported to that country from China. Other interesting matters are discussed by Dr. Jameson in this report, but space will not permit to give more than the headings of these subjects :—

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[1] J., Agri-Hor., Cal., VI., pt. ii.

1. On the method of preparing ground prior to forming a plantation, *viz.*, fencing, draining, ploughing, trenching, &c.
2. On seeds when ripe, the season of ripening, and the methods to be adopted to ascertain it.
3. On the method of sowing seeds and season, and on the treatment of the young tea plants after they have germinated.
4. Method of rearing plantations, by sowing seeds, by layers, and by cuttings.
5. On the method of transplanting, and the season.
6. On pruning, best season and mode.
7. On irrigation.
8. On the tea plant; season of flowering; its character and species; and on the advantages to be derived from importing seeds from China.
9. Method and season for plucking and gathering leaves.
10. On the method of manufacturing black tea.
11. On the method of manufacturing green tea.
12. Packing tea.
13. Manufacture of sheet-lead.
14. Tea manufacture.
15. Implements required in manufacturing tea.

In a letter to Dr. Royle, dated 25th January, 1849, Dr. Jameson states that 2,656lb. of tea had been manufactured in the previous season, of which 600lb. (black and green) had been sent to England, that there would be 400 acres under cultivation at Kaulagir by the end of the season, and at Páori he expected to have 2-3,000 acres. One hundred thousand plants were sent to the Kangra valley, and he hoped in the course of eight or ten years to have a sufficient number of plants in the Kaulagir plantation to plant the whole of the Dún.

Mr. Fortune.

In 1848, the services of Mr. Robert Fortune, already well known as a horticulturist, were engaged by the Court of Directors to make an expedition to the northern part of China in order to obtain plants of hardier varieties, as well as to investigate the mode of manufacture in that part of China. In all this he was completely successful. About 8,000 plants and several packets of seeds were despatched by him to India from localities celebrated for the good quality of their tea. He returned in 1851, bringing with him 12,000 *more plants*, together with a large quantity of seed in a germinating state. With these he proceeded at once to the Himálayan nurseries, which he afterwards inspected officially by request of Government. In his report on the condition of the nurseries he mentions eight as being at this time under Government control, *viz.*, one in Dehra Dún, one in Garhwál, and six in Kumaun. Their names are :—Kaulagir (Dehra Dún) : Gadoli (Garhwál) : Hawalbágh, Lachhmesar, Kapena, Anu, Kuasar, Bhartpur, and Rasiya (Kumaun).

Some remarks of his on each of the above may be briefly given here :—

1. *Kaulagir plantation.*—The soil is composed of clay, sand, and vegetable matter, on a gravelly subsoil of rocks similar to the surrounding mountains. The plants appeared less healthy than in good Chinese plantations owing (according to Mr. Fortune) to—
    (*a*) The flatness of the land : (*b*), the system of irrigation : (*c*), too early plucking : (*d*), hot drying winds.
2. *Gadoli.*—Soil composed of loam, sand, and vegetable matter, very suitable for tea. Very like a Chinese plantation ; plants healthy and prospects good.
3. *Háwalbágh.*—Land undulating similar to Chinese tea country ; soil a sandy loam mixed with vegetable matter ; land terraced and sloped. Terrace cultivation is not adopted in China.
4. *Lachhmesar* and *Kapena.*—Situation steep ; soil light and sandy, rarely irrigated ; plants in good order.
5. *Bhím Tál.*—(*a*) Anu and Kuasar : land low and flat, area 46 acres ; bad situation : (*b*) Bhartpur : 4½ acres of terraced land ; soil, light loam mixed with clay, slate, and trap rock and a small amount of vegetable matter ; well adapted for tea : (*c*) Rasiya, 75 acres of sloping land, plants most healthy, which are not irrigated.

Mr. Fortune also visited two plantations belonging to zamindars, the first called Lohba in Eastern Garhwál, 50 miles west of Almora, and at 5,000 feet altitude; excellent land. In 1844, 4,000 plants from the Government plantations were put here, but failed owing either to want of knowledge or intentional carelessness. The other plantation called Katyúr was situated near Baijnáth in Western Kumaun; the ground was undulating; there were numerous streams, and the soil was fertile. Captain (now General Sir H.) Ramsay's two plantations each of four acres were planted in 1850. Good management produced good results. The labour and manure of the two neighbouring villages were secured in lieu of taxes. At the close of his report Mr. Fortune gives some advice on certain points connected with tea cultivation in this part of India: (1) The land best suited for tea, he considered, should be undulating and well drained, and such as would produce good crops of *mandua* or wheat, moist but not stagnant. (2) Irrigation he declared to be generally injurious and should be resorted to only on emergencies. (3) Plucking in China was never carried on until the third or fourth year after planting, and was only necessary up to this time for forming good bushes; sickly plants should not be plucked. (4) The most suitable climate was to be found in Eastern Garhwál and Kumaon. At Háwalbágh, the thermometric readings showed a great similarity of climate with that of China. The rainy season in China is earlier, and the hottest time is in July and August, whereas in India the hottest month is June.

Outturn.

In appendix B. the annual yield of manufactured tea for each garden (between 1848 and 1868-69) is given as far as could be ascertained from scattered reports and office records. With the exception of the deductions from these figures, there is little to add regarding the later history of tea culture in these provinces beyond the general conclusion as to the ultimate success of the part which Government undertook with the able assistance of Dr. Jameson in order to bring about the complete establishment of the tea trade in North-West India. As early as 1864 Dr. Jameson was of opinion that, owing to the increase of private enterprise and the production of seed in private gardens, Government would be justified in handing over the tea plantations to private capitalists. "Government," he says, "has done its work in proving that tea can be profitably cultivated in North India. Seeds and seedlings have been distributed and skilled workmen supplied to planters in various parts of India." The extraordinary progress which occurred within a few years may be understood from the following facts :—In the year 1847, and up to 1859, tea cultivation was confined entirely to Government plantations, the total area being 166 acres. In 1859 the land under tea in Dehra Dún did not exceed 700 acres, and in Kumaon there was only one small private estate besides the Government plantations. In 1880 the area was as follows :—

			Number of gardens.	Area.		
				Acres.	Roods	Poles.
Kumaun	...	...	33	3,342	3	10
Garhwál	...	...	10	634	3	0
Dehra Dún	...	...	20	6,960	0	0
	Total	...	63	10,937	2	10

Indian teas in the Australian markets.

On the occasion of the recent International Exhibition at Melbourne the opportunity was taken of bringing *to the notice of the Australian people the* merits of Indian-grown teas. The undertaking was entirely successful, and the *prospects of Indian tea-planters have thereby received a* great impulse. They will now have a better chance of satisfying a *demand for Indian tea on its own merits, and the prejudice in* favour of Chinese tea which went so far as to encourage the doubtful *practice of selling Indian tea as that of China will undoubtedly* lose ground. The planters in Asám and Bengal will be more *directly benefited by these imports to Australia.* For *the teas of* North-West India a market closer at hand is required. Efforts are *now being made to renew and extend the* Indian tea trade beyond the borders of the North-Western frontier where the demand is *practically unlimited.* Mr. J. B. Fuller in his report on the foreign trade of the North-Western Provinces and Oudh makes *the following remarks* as to the advantages of opening up a trade between Kumaun and Tibet :—

"*So far as the commercial interests of these provinces are concerned, the* most interesting point in the traffic they transact with Tibet is the opening it might afford for the inferior classes of Kumaun tea, which will not bear the cost of carriage to the sea-board. At present the markets of Tibet are closed by the united influence of the Chinese Government and the Tibetan Lamas, who, having the monopoly of the wholesale and retail tea supply of the country, are naturally averse to the competition of a traffic in Indian tea, which might be more difficult to engross. The strict monopoly to which the tea trade between China and Tibet is subject is fully described in a recent report by Mr. Colbourn Baker, H. B. M.'s Consul at Chung Ching: his remarks, which specially relate to the prospects of a tea trade between Assam and Tibet, apply no less pertinently in the case of Kumaun, and the result of the system which he describes is that during the year under report not only was no tea exported to Tibet from these Provinces, but Chinese tea was actually imported into native Garhwál by the Nilang pass. 'Tea', Mr. Baker writes, 'is to the Tibetan more than a luxury: it is an absolute necessity' Yet the Tibetans on our frontier are compelled to purchase tea of atrocious quality, the price of which has been swelled by a long and difficult transport from the eastern extremity of the country; while immediately across the frontier there are tea gardens whence they could be supplied with a better article, at a cheaper price, and with profit to the Kumaun tea-planters as well as to the itinerant traders (Bhotias) through whose hands it would pass. The price of brick tea per lb. on the Kumaun-Tibet frontier is not known with accuracy, but since Mr. Baker shows that its price is increased from 4½ annas to 8 annas per lb., by transport from Bathang to Lhassa, which is not one-third of the way, its price on the Kumaun frontier must be very considerable and much in excess of what Kumaun planters could supply it for. Were the trade opened therefore the Tibetans would get cheaper as well as far better tea than what they at present consume, which in the words of Mr. Baker is 'the merest refuse,' consisting of little else than the twigs and brushwood of the tea plant, and vastly inferior to the very sweepings of Indian tea godowns. The tea-planting industry of Kumaun would benefit largely by the opening out of a trade, which would enable it to dispose of its coarser produce easily and cheaply. So heavily is Kumaun tea handicapped by the expense of transport to Calcutta that the most profitable portion of the trade even now is that transacted in green teas with merchants from Central Asia who purchase the tea at the factory and carry it away themselves, saving the planters the expense and trouble of packing. Kumaun planters are well aware of the advantages which a trade with Tibet would give them, and a former manager of the Kousani Tea Company actually manufactured brick tea and endeavoured, but unsuccessfully, to get it into Tibet. Lastly, the Bhotias, in whose hands the Tibet trade lies, would derive great benefit from the substitution of a new article of commerce for borax, the price of which has fallen under American competition too low to afford substantial profits on its import."

Tea in Dehra Dún.

The great success which has attended the cultivation of tea in Dehra Dún was hardly anticipated by Dr. Royle, who appeared to be decidedly in favour of a higher elevation. The locality which he recommended as being the most suitable for experiments in this district was a place called Jarrapani half way between Rájpur and Mussoorie and about 5,000 feet above the sea. The flatness of the ground in the Dún however was probably the chief cause of its being rejected in the first instance; for it had been observed that in China the finest tea plantations were situated for the most part on sloping ground.[1] Dr. Falconer, who succeeded Dr. Royle at Sahâranpur, on finding that the tea plant would grow even at Sahâranpur, was naturally led to a different conclusion, and it was at length decided to commence operations in the Dún. The first tea plants were introduced in 1842, and two years later the Kaulagir plantation was started under the superintendence of Dr. Jameson, who is still living to witness the successful results of his energy and perseverance.

Kaulagir.

In 1847 this piece of ground covered about eight acres. The plantation was added to from time to time until over 300 acres were under cultivation. It was visited in 1850 by Mr. Fortune, who was deputed by Government to inspect the tea plantations in India and to submit a report on their condition. The result of his visit led him to condemn the Dún as altogether unsuited for the cultivation of tea. The Kaulagir plantation happened just at this time to be in an unsatisfactory condition, but for reasons depending on the mode of cultivation, and not, as time has shown, on account of any radical defect in the locality. At any rate the defects, such as they were, were soon remedied by Dr. Jameson, and the good prospects of tea cultivation in the Dún were ensured. At a lecture given by Dr. Royle at the Royal Asiatic Society a letter from Captain Cautley was read in which he gave the following description of the Dehra Dún plantations :—"I saw the Government garden near Kaulagir, in which there were 4,000 plants growing most luxuriantly, the whole in full blossom. I believe that the whole of these, with the exception of a few brought from the hill plantations, are seedlings ; and certainly, as far as luxuriance of vegetation goes, I never saw anything so promising in my life. There cannot be a doubt of the tea growing luxuriantly in all this part of the Dún." Dr. Falconer was also present at this meeting and spoke strongly in favour of extending cultivation in the Dehra Dún, not only on account of the suitable climate and soil, but also because of the large amount of cleared land that was available in that locality; labour too, he maintained, was cheap as well as carriage.

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[1] Mr. Fortune was no doubt similarly influenced when criticising the condition of the plants at Kaulagir during his inspection tour in 1850.

The yield of tea and seeds from Kaulagir plantation during the years 1861 to 1865 is given below :—

	1861-62.	1862-63.	1863-64.	1864-65.	1865-66.
	lb	lb.	lb.	lb	lb.
Tea { Green ...	1,755				
Tea { Black ...	14,982				
Total ...	16,737	18,015¾	19,878½	25,078	36,202
	Mds.	Mds.	Mds.	Mds	Mds.
Seeds ...	660	1,307	860	1,050	1000
Remarks ...	Outturn lessened by severe drought.		Ten acres added to plantation.	Two acres added to plantation.	

This plantation after having remained for upwards of 23 years under Government management was sold in 1867 to the Raja of Sirmor for two lacs of rupees. In 1868 the receipts amounted only to Rs. 1,401, but the garden now promises to become a valuable source of income to the purchaser. In 1866 the road over the Mohan pass was constructed and a much more direct route was thus established for the carriage of tea from the Dún.

Other gardens.

Shortly after the formation of the Government plantation several other gardens were started in the Dún, including Harbanswala and Arcadia, both now belonging to the Debra Dún Tea Company, the largest and at the present time the most successful concern in the Dún. Many of the other gardens however failed, either from want of capital to start with, or because the managers were totally ignorant as to how the plant should be cultivated or the tea prepared. Since the year 1850 however the prospects of tea-cultivation have gone on improving and every year sees an increase in outturn and a finer quality of tea. In 1857 Dr. Jameson estimated regarding the tea-bearing capabilities of the Dún as follows : area 100,000 acres ; yield 10,000,000lb ; average per acre 100lb Although the additional land brought under tea cultivation is annually considerable, it seems improbable that such a large area as calculated by Dr. Jameson will ever be utilized for this purpose. On the other hand his estimate of outturn per acre was far too small, as will be seen by some detailed statements which follow. In 1863-64 only 1,700 acres were under tea cultivation.

Irrigation.

The question as to the effect of canal irrigation on tea plants seems to be finally disposed of. Fine healthy plants are now to be seen where formerly, when artificial irrigation was practised, the plants were sickly and sterile patches of soil were frequent. These patches were caused, it is supposed, by the excess of lime contained in the water; the low temperature of the water no doubt contributed to bring about the injurious conditions as described above. Artificial irrigation has therefore been altogether given up by most of the tea-planters in the Dún, and a marked improvement in the healthiness of the plants has been taken place in consequence. Other causes have also combined to bring about better results. Greater attention for instance is being given to the advantages of manuring. Firewood, an equally indispensable article, is yearly becoming more scarce, and is likely to prove a cause of anxiety for the future. Until recently a large quantity of tea used to be bought up by merchants from Kábul and Central Asia, who took it away with them in their own bags. Tea of very average quality was thus sold at from 13 annas to one rupee per lb. The trade with Kábul will in all probability be renewed now that hostilities with that country have ceased. The quality of the Dún teas as regards flavour and aroma has a close resemblance to that of the other kinds produced on the Himálaya in Kumaon and Kangra. Two varieties of the plant are cultivated, *viz.*, the China and a hybrid between it and the Asám plant, the latter being more closely related to the China than to the Asám variety. The Asám and Asám hybrid are found to be too delicate for cultivation in this part of India. There are at present twenty plantations in the Dún, making up a total area of 6,960 acres. The Dehra Dún Tea Company have lately introduced at their factories sets of rolling machinery which have proved to be a great saving of labour. The outturn of tea from the Dehra Dún Tea Company's plantations in 1879 was 313,058 lb., an average that is of 489 lb. per acre. The cost per acre amounted to Rs. 133-10-7.

APPENDIX B.

TEA STATISTICS.

Name of plantation.	1848.		1849.			1850.			1851.			1852.		1853.		1854.		1855.	
	Black.	Green.	Black.	Green.	Bohea.	Black.	Green.	Bohea.	Black.	Green.	Bohea.	Black.	Bohea.	Black.	Bohea.	Black.	Bohea.	Black.	Bohea.
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Kaulagir ...	37	32	167	114	44	58	385	247	219	107	132	1,103	178	3,583	584	5,388	874	9,882	2,681

In 1856, the production of black tea at Kaulagir reached 9,596 lb. of green tea, 1,658 lb. and of bohea, 4,774 lb. In 1857 the outturn was 4,501 lb. of black tea, 896 lb. of green tea and 922 lb. of bohea. The Páori garden yielded 2,251 lb. of black tea in 1853, 707 lb. in 1855, 1,844 lb. in 1856, only 32 lb. in 1857, 9,492 lb. in 1859-60, 10,247 lb. in 1860-61 and 12,964 lb. in 1861-62. The returns from Háwalbágh are nominal up to 1859-60. The Bhim Tál plantation yielded 1,476 lb. in 1859-60, 1,[illegible]70 lb. in 1860-61, 2,576 lb. in 1861-62, 2,251 lb. in 1862-63, 4,948 lb. in 1863-64 and 9,720 lb. in 1864-65. The remaining figures are as follows —

Name of plantation.	1859-60.		1860-61.		1861-62.	1862-63.	1863-64.	1864-65.	1865-66.	1866-67.	1867-68.	1868-69.	1869-70.	1870-71.
	Black.	Green.	Black.	Green.										
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Háwalbágh	2,277	5,229	5,660	1,401	6,067	6,242	7,977	8,131	13,291	15,174	11,473	12,355	4,961	5,231
Ayár Toli,	1,984	...	7,960	...	7,104	8,476	8,780	11,598	11,940	12,022	10,115	10,502	3,984	147
Kaulagir...	19,051	3,768	a14,982	*1,755	13,752	518,916	19,879	25,078	36,202	...	...	...	...	...

a The decrease in yield was owing to drought during the cold season and in April and May. There was, however, an abundant supply of seed this year, *viz*, 2,220 maunds, which was nevertheless unequal to meet the demand. Of the manufactured this year 16,000 lb. were sent to England and the rest was sold by auction.

† The dry weather during April and May affected all the plantations in North-Western India; hence the decrease in yield this year.

Receipts and Expenditure of the Government plantations, 1862-1869.

	1862-63.	1863-64.	1864-65.	1865-66.	1867-68.	1868-69.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
Receipts ...	*1,11,006	1,04,387	...	82,180	7,275	...
Expenditure,	66,000	64,300	50,109	58,000	26,000	14,507
Balance ...	40,006	40,087	...	24,180	...	...

* This does not include credit for 700,000 plants distributed gratis; also seeds for which Rs. 14,000 might have been realized by selling to planters in Kangra. The records are too imperfect to give the full details for each year.

Actual outturn of tea from plantations of Kumaon, Dehra Dún, and Kangra Valley for the last ten years:—

1871	... 619,072 lb.	1876	... 1,535,300 lb.	
1872	... 741,769 „	1877	... 1,398,785 „	
1873	... 981,851 „	1878	... 1,632,054 „	
1874	... 1,217,975 „	1879	... 1,800,000 „	uncertain.
1875	... 1,289,532 „	1880	... 1,945,181 „	
Estimated crop for 1881 ...		...	... 1,868,000 „	

DISTRIBUTION OF TEA SEEDS.

From the Kumaon, Garhwál and Dehra Dún Nurseries, 1860-67.

1860-61.	1861-62.	1862-63.	1863-64.	1864-65.	1865-66.	1866-67.
Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.	Mds. srs.
2,220 0	No record found.	2,859 32	2,301 0	2,842 0	2,103 0	1,643 0

The records for 1861-62 are not procurable.

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APPENDIX A. 1.

Table of rates according to which farmers of the forest dues in Kumaon were authorised to collect in 1847.

	A.	p.
Each cart-load of wood ...	6	0
" " *of sál logs (lattas)* ...	8	0
" wooden sugar-mill ...	8	0
" cart-load of rafters (*karís*),	6	0
" " of ebony ...	4	0
" " of bambus ...	6	0
" pony-load of ditto ...	0	6
" head-load of ditto ...	0	3
" bhangy-load of ditto ...	1	0
" cart-load of *bhábar* grass...	6	0
" pony-load ditto ...	0	6
" head-load ditto ...	0	3
" cart-load of *tái* reeds ...	6	0
" pony-load of ditto ...	0	6
" head-load of ditto ...	0	3
" cart-load of grass ...	6	0
" " of *múnj* ...	4	0
" bullock-load ditto ...	0	6
" head-load ditto ...	0	3
" *gún* of catechu ...	6	0
Each cart-load of burnt lime ...	12	0
" " kunkur ...	6	0
" pony-load of lime ...	0	6
" ass-load ditto ...	0	3
" pony-load of lac ...	4	0
" head-load of ditto ...	2	0
" pony-load of *pipármor* ...	4	0
" head-load of ditto ...	2	0
" cart-load of charcoal ...	4	0
" bhangy-load of baskets ...	1	0
" ditto of wooden utensils,	1	0
" head-load of ditto ...	0	6
" pony-load of *ruina* ...	4	0
" head-load of ditto ...	2	0
Catechu furnaces.	Rs	a.
One in Kota	7	8
" " Chaubhainsi... ...	4	0
" " Talládes	2	8
" " Chhakháta	5	8

The grazing dues were three annas for each buffalo and one anna for each cow or bullock pasturing in the Bhábar during the year, with the following exemptions:—Calves of all kinds up to two years of age, all cattle actually employed in carriage, all cattle *boná fide* the property of a hill head-man possessing a lease, all cattle passing through and not staying more than five days, all cattle belonging to the head-men of the Bhábar villages, and all belonging to cultivators actually residing in the Bhábar all the year round.

APPENDIX A. 2.

The following table shows the duties which the farmers were permitted to levy by Mr. Shore[1] in Dehra Dún in 1826:—

Table of duties levied in the Dún forests in 1826.

Article.	Per 4 bullock cart = 20 maunds.			Per 3 bullock cart = 15 maunds.			Per 2 bullock cart = 10 maunds.			Mule or buffalo = 4 maunds.			Bullock or pony = 3 maunds.		Ass-load = 1½ maunds.		Head-load = ½ maund.	
	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	A.	p.	A.	p.	A.	p.
Sisu, *tún* and ebony of any size.	5	0	0	3	12	0	2	8	0	1	0	0	12	0	6	0	3	0
Each wooden sugar-mill,	0	12	0	0	12	0	0	12	0	...			...		...		...	
Bambus ...	0	6	0	0	4	6	0	3	0	0	1	0	0	9	0	6	0	3
Beam for sugar-mill ...	1	0	0	0	12	0	0	8	0	0	3	0	2	0	1	0	0	6
Sál of any size ...	0	8	0	0	6	0	0	4	0	0	1	6	1	0	0	6	0	3
Fire wood and timber not expressly specified.	0	6	0	0	4	6	0	3	0	0	1	0	0	9	0	6	0	3
Babar and *múnj* grass	0	8	0	0	6	0	0	4	0	0	1	6	1	0	0	6	0	3
Ringáls for hukka stems,	3	0	0	2	4	0	1	8	0	0	10	0	7	6	4	0	2	0
Nal reed for matting ...	1	4	0	0	15	0	0	10	0	0	4	0	3	0	1	6	0	9
Khat or catechu ...	5	10	0	4	3	0	2	13	0	1	2	0	14	0	7	0	3	6
Lac	1	12	0	1	5	0	0	14	0	0	5	6	4	0	2	0	1	0
Lime	0	4	0	0	3	0	0	2	0	0	0	9	0	6	0	3	0	2
Charcoal	0	8	0	0	6	0	0	4	0	0	1	6	1	0	0	6	0	3

APPENDIX A. 3.

REVENUE OF EACH FOREST DIVISION.

Year.		Kumaon	Naini Tál.	Ráníkhet.	Garhwál.	Dehra Dún.	Bhagírathí.	Jaunsár Báwar.
		Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1865-66	...	2,59,544	...	...	2,49,305	40,431	...	...
1866-67	...	1,60,369	...	...	2,28,357	43,720	...	...
1867-68	...	1,78,459	...	..	1,77,359	41,156	...	...
1868-69	...	1,72,661	...	...	1,88,733	40,333	...	...
1869-70	...	2,55,393	...	...	1,48,972	84,262	4,508	...
1870-71	...	1,05,601	...	...	1,11,746	31,043	15,451	36,589
1871-72	...	1,10,152	...	1,205	1,30,380	96,819	5,36,924	1,28,801
1872-73	...	2,07,339	1,016	1,981	2,08,700	90,293	6,94,013	3,23,834
1873-74	...	3,05,087	1,340	3,292	1,53,706	78,270	4,60,591	5,12,336
1874-75	...	2,76,372	1,720	6,000	1,16,946	81 805	2,84,376	2,62,017
1875-76	...	2,07,334	5,121	16,697	2,00,046	67,521	1,00,480	2,22,247
1876-77	...	2,18,166	18,010	11,885	1,40,322	67,033	87,964	2,03,028
1877-78	...	1,79,364	15,285	12,073	1,73,348	77,221	1,21,120	2,07,098
1878-79	...	1,70,850	17,155	53,364	1,31,875	48,490	1,02,822	2,02,436
1879-80	...	1,65,574	21,426	7,165	1,11,704	41,482	50,970	2,14,456

Note.—In 1879-80 the Tons division was separated from Jaunsár-Báwar, and for that year the adjusted accounts show Rs. 43,875 for Jaunsár-Báwar and Rs. 1,70,581 for the Tons division.

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[1] Mr. Shore to Commissioner, Kumaon, 15th September, 1826.

APPENDIX A 4.

EXPENDITURE OF EACH FOREST DIVISION.

A.—Conservancy and Working: B.—Establishment.

Year.	Kumaun.		Naini Tál.		Ránikhet.		Garhwál.		Dehra Dún.		Bhagirathi.		Jaunsár-Báwar.	
	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1865-66 ..	61,801		...	...	...	...	81,717	11,641	25,639	28,780	...	...	...	...
1866-67...	86,024	28,431	...	...	...	...	95,265	10,156	23,429	28,988	...	...	...	...
1867-68 ..	83,067	26,613	...	...	...	...	40,433	12,055	11,976	22,629	...	...	...	...
1868-69...	49,481	18,172	...	...	...	...	54,104	19,566	22,111	23,980	...	...	...	...
1869-70 ..	47,574	26,644	...	...	...	...	58,720	12,241	25,571	24,937	77,242	13,008	...	...
1870-71 .	1,03,198	26,138	...	...	...	...	46,694	11,462	23,104	22,459	2,18,893	12,544	1,53,725	
1871-72...	54,867	21,114	...	...	4,034	3,070	48,098	14,946	39,054	19,321	3,49,030	18,436	2,57,800	
1872-73 ..	69,755	21,606	476	731	3,224	6,509	43,540	18,023	22,590	23,695	4,12,035	13,393	3,37,766	
1873-74...	54,974	25,414	578	807	2,569	7,459	57,787	17,479	28,326	20,805	4,10,643	13,459	2,47,668	23,873
1874-75...	57,641	25,389	348	710	2,029	10,751	45,016	16,173	25,451	22,504	3,80,079	14,307	1,76,170	16,741
1875-76 ..	80,599	26,833	1,602	1,298	4,351	11,321	64,677	20,515	10,786	14,685	69,940	14,660	1,44,564	22,952
1876-77...	66,754	17,144	6,329	2,164	7,301	8,661	63,625	20,157	19,108	19,086	1,29,862	13,357	1,97,491	19,179
1877-78...	54,055	21,150	7,233	2,415	5,277	13,053	37,970	19,480	21,189	28,431	48,397	9,011	2,00,637	20,827
1878-79 ..	47,534	23,328	5,743	2,549	22,612	12,991	34,880	21,669	15,420	23,513	82,176	4,658	1,89,252	27,156
1879-80...	50,036	23,613	19,125	1,880	6,457	10,900	44,051	24,204	9,855	18,703	14,312	7,148	1,15,400	24,374

Note.—In 1879-80 the Tons division was separated from Jaunsár-Báwar, and of the expenditure recorded against the former Rs. 68,318 (Rs. 66,282 A. and Rs. 2,036 B.) belongs to the latter.

APPENDIX A.5.

Schedule of tolls on the export of minor forest produce in the Kumaun forest division.

No.	English and botanical or vernacular names.	Loaded in carts.		Loaded animals.								Average annual export.
		Royalty per ox.	Royalty per buffalo.	Per camel.	Per buffalo.	Per ox	Per pony.	Per donkey	Per bangly.	Per head-load.	
		Rs. a. p.	Rs. a p.	Rs. a. p	Re. a. a	Rs. a. p.	Re. a. p.	Re. a. p	Re. a. p.	Re. a. pi	
1	Grass and reeds	0 6 0	0 8 0	0 5 0	0 2 6	0 2 0	0 2 0	0 1 6	0 1 3	0 0 9	24,500 loads.
2	Typha elephantina	0 4 0	0 5 0	...	0 1 0	0 0 9	0 0 9	0 0 6	0 0 6	0 0 3	20 „
3	Ditto thin and palm leaves ..	0 5 0	0 6 0	...	0 1 6	0 1 0	0 1 0	0 0 9	0 0 9	0 0 6	...
4	Grass for thatching	0 2 0	0 3 0	0 1 6	0 1 0	0 0 9	0 0 9	0 0 6	0 0 6	0 0 3	8,000 „
5	Reeds	0 2 6	0 3 0	...	0 1 3	0 1 0	0 1 0	0 0 9	0 0 9	0 0 6	1,029 „
6	Grass and bambu leaves ...	0 1 6	0 2 0	0 0 9	0 0 9	0 0 9	0 0 9	0 6 0	0 0 6	0 0 3	17 „
7	Wooden tubes (*bánsi*) ...	0 12 0	1 0 0	...	0 6 0	0 4 0	0 4 0	0 3 0	0 2 0	0 1 0	...
8	Firewood (*sokhta*)	0 2 3	0 3 0	0 1 6	0 1 0	0 0 9	0 0 9	0 0 6	0 0 6	0 0 3	33,500 „
9	Charcoal (*koila*)	0 12 0	1 0 0	...	0 5 0	0 3 0	0 3 0	0 2 0	0 1 6	0 1 0	27,500 mds.
10	Limestone	0 6 0	0 8 0	0 4 0	0 4 0	0 3 0	0 3 0	0 1 6	0 1 6	0 1 0	} 52,000 loads
11	Burnt lime	1 0 0	1 4 0	1 0 0	0 8 0	0 5 0	0 5 0	0 3 0	0 2 6	0 1 3	
12	Bark of the Zizyphus ...	0 4 0	0 6 0	0 2 0	0 2 0	0 2 0	0 2 0	0 2 0	0 2 0	0 1 0	...
13	Circle of sieve	2 0 0	2 8 0	...	0 8 0	0 6 0	0 6 0	0 4 0	0 4 0	0 3 0	...
14	Hemp (*bhang*)	0 6 0	0 8 0	0 4 0	0 4 0	0 4 0	0 4 0	0 2 0	0 1 6	0 1 0	170 mds.
15	Cane (*bet*)	0 12 0	1 0 0	...	0 5 0	0 3 0	0 3 0	0 2 6	0 2 0	0 1 6	48 loads.
16	Chalk or pipe clay (*khaira matti*),	0 3 0	0 4 0	...	0 1 0	0 0 9	0 0 9	0 0 6	0 0 6	0 0 3	180 „
17	Horns of cows and buffaloes ...	0 8 0	0 10 0	0 4 0	0 4 0	0 4 0	0 4 0	0 4 0	0 3 0	0 2 0	7,000 ps.

No.	English and botanical or vernacular names.	Measurement.	Royalty.	Rs.	a.	p.	Average annual export.
18	Acacia Catechu (*churan*)	Length up to 10′ girth to 30″.	Per score	14	0	0	Scores. 2,000
19	Do. (*mámla*) ...	„ 5′ „ 30″ ...	„	6	4	0	
20	Do. (*balli*) ...	Length as it may be 12″	„	4	1	0	
21	Do. (*músal*) ...	Length up to 8′ girth 8″.	Per each	0	3	0	
22	Do. (parts of carts)	„ 14′ 8″ ...	„	0	1	0	
23	*Do* (*ditto*) ...	„ 5′ 10″ ...	„	*0*	*1*	*0*	
24	Large bedsteads made of sál, sisu, sandan.	Girth of legs, heads above 17″	„	0	12	0	Pieces. 4,800
25	Do. of other woods	Ditto ...	„	0	5	0	
26	Do. as 24 ...	Girth of legs, heads up to 16″	„	0	8	0	
27	*Do* as 25 ..	*Ditto* ..	„	*0*	*3*	*0*	
28	Legs of bedsteads as 24.	Girth of heads above 17″	„	0	2	0	
29	Do. as 25 ...	Ditto ...	„	0	0	9	
30	Do. as 24 ...	Girth of head up to 16″	„	0	1	0	
31	Do. as 25 ...	Ditto ...	„	0	0	6	
32	Small bedsteads as 24.	Length up to 7′ girth to 10″	„	0	1	6	
33	Do. as 25 ...	Ditto ...	„	0	0	9	
34	Do. as 24 ...	Length up to 4′ girth to 10″	„	0	0	9	
35	Do. as 25 ...	Ditto ...	„	0	0	6	
36	Boxes as 24 ...	Length up to 3′ girth above 60″	„	1	4	0	
37	Do. as 25 ...	Ditto ...	„	0	10	0	
38	*Do. as 24* ...	*„ girth 31″ to 60″*	„	*0*	*10*	*0*	
39	Do. as 25 ...	Ditto ...	„	0	5	0	
40	Do. as 24 ...	„ girth up to 30″	„	0	4	0	
41	Do. as 25 ...	Ditto ...	„	0	2	0	
42	Bambus *saraincha bahga.*	...	Per 100 scores.	12	0	0	37,800 scores.
43	*Kanderu* ...	...	„	9	0	0	96,000 „
44	*Chhaneju* and *chhari.*	...	„	7	0	0	190,000 „
45	*Paina* ...	...	„	4	0	0	28,000 „
46	*Balli*	Long up to 24 feet	Each	0	0	6	8,000 „
47	*Doli*	„ 25′ or over.	„	0	1	0	2,000 „
48	*Bhábari* ...	...	Per 100 scores.	14	0	0	with 44.
49	*Chiralund* for utensils.	...	Per head-load.	0	4	0	...
50	Large bambu box,	...	Each	0	1	0	Pieces, 16,000
51	Small ditto and basket.	...	„	0	0	6	
52	Ditto basket ...	...	„	0	0	3	
53	Sticks and fishing rods.	...	„	0	0	2	18,000

No.	English and botanical or vernacular names.	Royalty.				Average annual export.
			Rs.	a.	p.	
54	Scale plates	Each	0	0	1	4,000
55	Matting (*chatái*)	Per yard	0	0	3	3,400
56	Box made of cane, large ...	Each	0	1	0	...
57	Do., small	"	0	0	9	...
58	Skin of Bárasingha	"	0	8	0	Pieces 80,000
59	Do. cow, buffalo, camel, large ...	"	0	4	0	
60	Do. do. deer, middling ...	"	0	2	0	
61	Do. do., small	"	0	1	0	
62	Do. sheep and goats	"	0	0	6	
63	Shoes	"	0	0	6	
64	Horns of stag, deer, &c.... ...	"	0	0	6	In 17.
65	Footstools (*mora*)	"	0	1	0	
66	Ropes of *máljan* and *boddla* ...	"	0	0	3	
67	Each gold-washing sieve ...	"	5	0	0	
68	Cart wheels, large	"	1	12	0	
69	Ditto, small, ...	"	1	4	0	
70	Parts of carts	"	0	4	0	
71	Stools (*pira*)	"	0	1	6	...
72	Wooden platters and pots, large ...	"	0	1	0	45,000 pieces.
73	Ditto, small ...	"	0	0	9	
74	Ditto, large of *B. malabaricum*,	"	0	0	9	
75	Ditto, middle ...	"	0	0	6	
76	Ditto, small ...	"	0	0	3	
77	Wooden shoes	"	0	0	3	...
78	Sealá beams, spoons, and sieves ...	"	0	0	1	...
79	Nigall (*dawat* and *takhti*) ...	"	0	0	3	...
80	Spinning wheels	"	0	2	0	...
81	Drums	"	0	1	6	...
82	Native musical instruments (*dutara*),	"	0	0	3	...
83	Gun stocks	"	0	0	6	...
84	Various seeds dry and gums ...	Per seer	0	0	3	650 maunds.
85	Ditto green ...	"	0	0	1	400 "
86	Ditto do. and resins,	"	0	0	9	150 "
87	Ditto roots and fibres ...	"	0	0	6	405 "
88	Bark of the pomegranate ...	"	0	4	0	6,800 "
89	Powder of *Mallotus phillipinensis* ...	"	0	2	0	175 "
90	Various drugs	"	0	1	6	170 "
91	*Piper longum*	"	0	2	6	550 "
92	Piper *Rubia, cordifolia*, honey, &c. ...	"	0	1	0	900 "
93	Bánslochan	"	1	10	0	5 "
94	Lac	"	0	1	3	713 "
95	Catechu	Per maund	9	0	0	3,000 "
96	Seeds of *Prinsepia utilis* (*tatúwa*) ...	"	1	4	0	6 "
97	Dried root of *Datisca cannabina* ...	"	1	0	0	4 "
98	*Myrica sapida*, khas-khas, and gum...	"	0	8	0	1,800 "
99	*Cinnamonum Tamala*, &c. ...	"	0	4	0	848 "
100	*Woodfordia floribunda, &c.* ...	"	0	4	0	2,200 "
101	Drugs of sorts	"	0	4	0	100 "
102	*Ritha* &c., ...	"	0	4	0	500 "
103	Drugs of sorts	"	0	2	0	100 "
104	Ditto	"	0	3	0	150 "
105	Bark of Cinnamonum *Tamala* ...	"	0	12	0	616 "
106	Drugs of sorts	"	0	6	0	80 "
107	String and rope of *múnj* and *bábar* ...	"	0	8	4	75 "
108	Wax	"	10	0	0	173 "
109	Resin of *Pinus longifolia* (*birja*) ...	"	1	4	0	86 "
110	Ditto *bákhar-birja* ...	"	0	8	6	50 "
111	Rhubarb (*dolu*)	"	0	12	0	11 "
112	*Acorus calamus* (*bach*)	"	0	4	0	640 "

NOTES ON THE ABOVE LIST.

1. Includes—

(a)—*Bábar*, the grass of *E. comosum*, *S. angustifolius*, and others referred to at p. 808.

(b)—*Bind*, the leaves of *S. munja*, used for thatching.

(c)—*Bindu*, the leaves of other reeds used for the same purpose.

(d)—*Múnj* and *sirki*, parts of *S. munja*.

(e)—*Tát*, the culms of *S. fuscum* and *C. laniger*.

(f)—*Sink*, the culms of *Anatherium muricatum*.

3. Includes small reeds of the *patera* (*T. Elephantina*), the reeds of the *motha* (*Cyperus tegtiformis*) and the leaves of the *khajúr* (*Phœnix sylvestris*).

5. Includes the reeds of the *nal-tura* (*Phragmites nepalensis*).

6. Includes the leaves of the *sirála* (*Andropogon species*) and bambu used for fodder.

43. See page 810.

67. These are ropes made from the *máljan* (*Bauhinia Vahlii*), page 793, and *bodála* (*Sterculia colorata*), page 792.

68. A royalty is levied on each sieve or rocker used by the gold-washers.

85. Under this head comes the following:—

Dry *aonla*, the fruit of *P. Emblica* known as Emblic myrobalans, page 777.

Dry *haraira*, the fruit of *T. Chebula* known as Chebulic myrobalans, page 779.

Mocharas, the gum of the *Bombax malabaricum* (page 784) and *Moringa pterygosperma* (page 784), *Mochkand*, the root of *Eclipta erecta*, page 785.

Roli-ki-dána, the seeds of *Mallotus phillipinensis* (page 770).

86. Under this head we have the green fruit of the *aonla* and *haraira*.

Dry *bahera*, the fruit of *T. belerica*, known as Beleric myrobalans, page 777.

Amaltás, the pods of *Cassia fistula*, page 779.

Túlsi, the leaves of *Ocimum sanctum*, and the flowers of the *dhák* or *Butea frondosa*, page 778.

87. Under this come:—

The resin of the *sál* (page 785) and the galls of *Pistacia integerrima* known as *kakrasíngi*, page 740.

88. Under this head are included the following fruits, roots and fibres:—

Green *pípla*, the fruit of *Piper silvaticum*, page 705.

Kála-jíra, the fruit of *Carum Carui*, page 705.

Bilái-kand, the tubers of *Pueraria tuberosa*, page 748.

The fibre of the pods of the cotton-tree, *Bombax malabaricum*, page 791.

91. Under this head we have the following:—

Kaldi.

Kútki, plants of the genus *Ophelia* used for bitters, page 744-46.

Bálchar, root of *Nardostachys Jatamansi*, page 743.

93. Under this head the following are included:—

Píplamor, the *Piper silvaticum*, page 705.

Manjít-ka-jar, root of *Rubia cordifolia*, page 773.

Ratti, seeds of *Abrus precatorius*, page 724, and *sahat*, honey.

94. Is the silicious secretion from the joints of the bambu, also known as *tabáshír*.

98. See page 742.

99. See pages 705.

100. See page 705 for *C. Tamala*. This head also includes:—

Roots of various kinds exported as *kand* and *Kinjora-ki-jar*, the roots of the different species of *Berberis*, page 728.

The seeds of *Pharbitis Nil* (*kála-dána*), page 745; and the roots of *Hedychium spicatum* (*kapúr-kachri*), page 738.

101. This head includes the following:—

Dhái-ke-phúl, the flowers of *Woodfordia floribunda*, page 778, *Chhalaru* oak-bark. *Pakhán-bed*, the root of *Saxifraga ligulata*, page 749. *Nisot*, the root of *Ipomœa turpethum*, and the bark of *Symplocos cratægioides* (*lodh*), page 776.

102. Under this head come the following:—

Túng, the bark of *Rhus Cotinus*, flowers and bark of *Cedrela Toona*, page 779. *Nagarmotha*, roots of *Cyperus juncifolius*, page 774. *Pit-pápra*, seeds and leaves of *Fumaria parviflora*, page 737, fruit of *Elæagnus umbellata*, page 756, and seeds of *A. Catechu*.

103. Includes *Ritha*, the seeds of *Sapindus detergens*, page 749; *Selkhari*, a white clay and *manjít*.

104. Comprises *giloi*, the roots of *Tinospora cordifolia*, page 752, medicinal herbs of sorts and *phindaru* (*Colocasia himalensis?*)

105. Includes various mineral drugs.

107. Includes *Rhus vernicifera*, page 785, and *makoi*.

APPENDIX A.6.

List of rates for the sale of timber at Rámnagar and Moradabad Government Forest Depots.

Name of timber.	Measurement	Class.	Rate per cubic foot at Rámnagar.	Rate per cubic foot at Moradabad.
			Rs. a. p.	Rs. a. p.
Sál karis	12′ × 6″ × 1″	I	1 5 0	1 8 0
Ditto	Ditto ...	II	0 15 6	1 2 0
Ditto	Ditto ...	III	0 8 0	...
Ditto	10 × 5 × 4	I	1 5 0	1 7 0
Ditto	Ditto ...	II	0 15 0	...
Ditto	Ditto ...	III	0 8 0	...
Ditto	13 × 6 × 5	I	1 6 0	...
Ditto	Ditto ...	II	1 0 0	...
Ditto	8 × 4 × 4	II	0 15 0	...

List of rates for the sale of timber at Rámnagar and Moradabad Government Forest Depots—(*concluded*).

Name of timber.	Measurement.	Class.	*Rate per cubic foot at*	
			Rámnagar.	Moradabad.
			Rs. a. p.	Rs a. p.
Sál karis.	8×4×4	III	0 6 0	...
Ditto	6×4×4	II	0 14 0	...
Ditto	Ditto	III	0 4 0	...
Jáman karis	10×5×4	II	0 4 0	...
Ditto	Ditto	III	0 2 6	...
Haldu karis	12×5×4	I	0 0 0	...
Ditto	Ditto	II	0 4 0	...
Chír karis	Ditto	I	0 8 0	...
Ditto	Ditto	II	0 6 0	...
Ditto	10×5×4	I	0 8 0	...
Ditto	Ditto	II	0 6 0	...
Sál sleeper	10′ × 32″	...	0 8 0	...
Sál karis	15×5×4	II	...	1 4 0
Sál logs squared with axe if purchased unselected from one end of the line five logs or over.	...	...	1 10 0	...
Ditto ditto selected	...	...	1 14 0	...
Ditto round, class I., if purchased unselected from one end of the line 10 logs or over.	...	...	1 8 0	1 14 0
Ditto ditto selected	...	...	1 12 0	2 0 0
Ditto round mixed class if purchased unselected from one end of the line 10 logs or over.	...	...	1 6 0	...
Ditto ditto selected	...	...	1 12 0	...
Ditto round, class II., if purchased unselected from one end of the line 10 logs or over.	...	...	1 4 0	...
Ditto ditto selected	...	...	1 12 0	...
Sál kolhus selected	...	...	1 10 0	2 0 0

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